NEW BRUNSWICK HERBICIDE MANUAL

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G.C.M.

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INTRODUCTION

The application of herbicides should be regarded as only one tool in forest management. To obtain the optimum wood fiber production per unit area the forest manager must achieve a successful integration of site quality, type and condition of the planted or natural stock, type of harvest of previous stand, silvicultural treatments (e.g. scarification, burning, thinning) and timing of treatments and planting within economic constraints. In addition to influencing wood production these factors may also circumvent or enhance the desirability of herbicide application. This manual will deal with only one facet of this broad management endeavor, that of herbicide usage. Any references to other forms of management are only made in light of specific effects (be they known or predicted) pertaining to the use of herbicides.

The phenology of the most common weed species in New Brunswick is extremely variable. Methods of propagation on disturbed sites include stump sprouting, root suckering, prolific seed dissemination and buried seed strategy (e.g. raspberry, pin cherry). This variability makes prevention and control of weed competition problems difficult, which emphasizes the need for appropriate herbicide formulation availability. The severity of such competition problems generally appears to be directly proportional to site quality (fertility and degree of drainage) and the amount of soil disturbance. Thus, scarification of a site following harvesting normally increases the probability of competition problems.

This manual is subdivided into two portions. The first portion (Part I) involves the decision-making process regarding the timing (which year), and indeed the necessity, of herbicide application on any particular site. In actual fact it explores the relationship between the crop species and the target species as well as the subsequent response of the crop species to a particular herbicide treatment. Due to the shortage of long-term quantitative data on changes in wood volumes at predicted time of operability (in terms of both increased survival and reduced rotation length) attributable to specific herbicide applications, this section relies heavily on conjecture and opinions of personnel involved in this relatively new field of forest management. Although definitive prescriptions are, as of yet, impossible to formulate it is hoped that the numerous factors and considerations presented will enable forest managers to make sound management decisions regarding herbicide usage.

The second portion (Part II) of this manual deals with the somewhat more refined mechanics or procedural technology of herbicide application; in essence, the relationship between the herbicide and the target species. Considerable information has been collected regarding concentrations, amounts, adjuvants, droplet size and timing of application (time of year) of specific herbicide formulations to achieve the desired objectives of target weed species control. Refinement of this information will continue as new data is collected and additional herbicides become marketable. Part II is an attempted assimilation of this information as it pertains to the New Brunswick situation.

PART I

HERBICIDE PLANNING

The adverse effects of weed species on crop species can be summarized as: (1) competition for light, moisture and nutrients, (2) physical damage (e.g. leaders of crop species trees being damaged by interference from the leaves or stems of weed species), (3) provision of favorable habitat for animals that cause damage to the crop species trees, (4) reduction of available growing space, (5) restriction of air movement, (6) potential alternate host of viruses or diseases that might infect crop species trees. These must be weighed against any beneficial effects of weed species such as: (1) prevention of wind and frost damage to crop species trees, (2) prevention of site deterioration (surface evaporation, erosion, frost heaving, etc.), (3) maintenance of site diversity, (4) prevention of long-term nutrient losses from the site. The importance of these beneficial effects will vary depending upon the hardiness and site suitability of the seedling stock, as well as the amount of regrowth of non-target species following herbicide application. Considerations of hardiness and adaptability will differ between natural regeneration areas and plantations; in plantations the type and condition of the planted stock are very important. For example, frost damage to planted seedlings should normally be preventable by correct matching of the seedling stock with the site, regardless of the amount of protection provided by weed species. Smaller, poorer quality stock may be more susceptible to competition problems.

A decision must be made by the forest manager as to whether the adverse effects of the weed species are currently, or are predicted to be, serious enough to warrant herbicide treatment and, if so, when (which year) such treatment should take place. Such a decision must be made in light of previously established management goals and as much knowledge as possible of the particular site (fertility, drainage, aspect, disturbance history, outcome of disturbances on adjacent sites). Management goals should clearly outline for the manager a tolerable level of competition and include a built-in integration of how weed competition on individual trees subsequently affects stand and overall annual wood fibre production. The currently predicted shortfall of softwood in the next century and emphasis on intensive site management adds greater impetus to optimization of wood volume per unit area over the shortest possible time. This may necessitate a reduction in the tolerable amount of weed species to ensure that trees of crop species are provided with the best possible opportunity for uninhibited growth.

In the absence of clear guidelines, decisions regarding herbicide usage will be understandably variable depending upon the attitude and past experiences of each forest manager. The development of a uniform "competition index", which incorporates some measure of the stocking and relative dominance of each weed species, would substantially reduce such biases. However, such an index is difficult to formulate for several reasons: (1) accurate stocking and dominance estimates of weed species normally require considerable measurement and time due to the heterogeneous distri-

bution of weed species within any potential treatment area, (2) the interaction of two or more weed species is difficult to simultaneously and uniformly quantify, (3) the severity of any particular "competition index" will vary with the type(s) of adverse effect exerted. Furthermore, there is no reliable method of uniformly translating amount of competition into long-term effects on wood volume production. There is ample evidence of substantial increases in growth and survival of softwood species associated with appropriate herbicide treatments but the high number of variables involved, in addition to alterations in both herbicide formulations and application technology, precludes definitive quantification of this response pattern.

The most cost effective approach in dealing with herbicide treatment as a silvicultural tool is obviously to utilize it when and where the return from the investment is expected to be maximal. The possibility of reduced survival (hence reduced stocking) should provide the impetus for a herbicide treatment; no longer is there only a delay in obtaining the desired wood volume per unit area but this volume will never be achieved. As previously mentioned, the potential for weed problems is normally high on relatively high quality, well-drained sites that have been subjected to extensive soil disturbance; such sites should have a high priority for treatment, particularly as they may sustain better growth rates of crop species. Current advances in site classification technology, and anticipated predictive refinements, will aid in identification of these good quality sites as well as improvement in matching of crop species with particular sites.

Theoretically, the more adapted a crop species is to a particular site the greater the chance of minimization of herbicide treatment.

The relationship between the phenology and development rate of the crop and weed species will often determine the necessity of herbicide treatment, or retreatment, and when this should take place. For example, planting of an initially fast growing species, such as jack pine, on a site anticipated to have extensive competition may be advisable. Similarly, jack pine has a deeper rooting system than do the spruces which is advantageous on sites having dense root mats of ericaceous or grass species.

The most common competitors of softwood species in New Brunswick include the soft maples (red, striped, mountain), white and grey birch, pin cherry, aspen, beech, ericaceous species, grasses, sedges and red raspberry. Due to the tremendous biomass and extensive, uniform coverage it can achieve, raspberry is generally regarded as the most detrimental competitor. In addition to reducing growth it has potential to reduce survival of softwood seedlings. On or around the third year of site occupancy by this species there is an exponential increase in its biomass. Once this occurs its competitive effect is much greater and control is more difficult to accomplish; management should thus strive for herbicide treatment prior to this increase.

The year of herbicide treatment will depend upon the amount and timing of site disturbance and the reestablishment (planted or regenerated naturally) of the crop species, as well as the phenology of both the crop and weed species. Treatments may take place

prior to establishment of the crop species, as a "site preparation" operation or after establishment, as a "release" operation. The term "release" connotes not only removal of current growth inhibitors but also predicted future growth inhibitors; in other words, removal of competing species before they become a problem.

Site preparation treatments are particularly advantageous when crop species sensitive to herbicides, such as larch and jack pine, are being utilized. Larch, in particular, is quite intolerant of release treatments. Sites that currently have large amounts of competing species and no crop species, normally due to a delay in crop species reestablishment following site disturbance (i.e. harvesting of prior stand), should be considered for site preparation herbicide treatment. Management should strive for a short as possible time between stand harvest and reestablishment; this returns the site to wood fiber production quickly, provides seedlings with the benefits of the flush of nutrients normally accompanying stand removal and may provide crop species with a competitive advantage over competing species (influencing the necessity of a herbicide treatment). Site preparation treatments provide the maximum potential for uninhibited growth of the crop species; they are desirable when it is felt that the crop species can outgrow or outcompete any future ingrowth of competing species or when indirect adverse effects of competing species (e.g. increased incidence of browsing) are expected to be immediately problematic to newly established seedlings. The organic matter content of the soil should also be considered in the planning of any soil sterilization treatment.

In addition to possible adverse effects on site quality, such as frost damage and site deterioration, the main disadvantage of site preparation treatment is the possibility of ingrowth of weed species prior to crop species trees attaining a "safe" height, necessitating another treatment. The phenology of the weed species currently, or expected to be, present is an important consideration. For example, all buried raspberry seed may not germinate in the first year following disturbance. If site preparation treatment occurs in this year only the germinants will be killed; second year germinants may result in a competition problem.

It may therefore be advisable, depending on the crop species, to delay any herbicide treatment until after stand reestablishment, particularly if competition is not currently considered excessive. In fact, there must be a trade off between the possibility of inhibited crop species growth during the initial stand establishment stage and minimization of the number of herbicide treatments. This trade off will be influenced by specific management goals and associated economic constraints. Release treatments should normally take place the first or second growing season after stand establishment (e.g. planting); if competition is going to be a problem on a particular site it is usually evident by this time. Release treatment carried out in the same year as planting might result in damage to planted stock and may also be prohibited by the herbicide manufacturer; nevertheless, it is a consideration when naturally regenerated areas or areas planted with "bare-root" stock are involved. Depending upon the severity

of the competition and the effectiveness of the application, an additional release treatment may be necessary before the seedlings attain a size sufficient to negate competition from weed species.

Accurate prediction of future weed problems on a particular site is made more critical by the fact that the allowable time period for herbicide release application is limited, being generally restricted to the late summer and early fall. Application of foliar herbicides must take place after crop species trees have "hardened-off" (shoot growth ceased and buds formed) for the season but before leaf frost damage to the target species. As a general rule natural regeneration should be treated first, followed by "bare-root" and then "container" plantations. This varies somewhat by the crop species. Additionally, on some sites a dense amount of target species foliage may be considered to provide sufficient protection for the still "lush" crop species foliage. Spring applications are theoretically possible but are logistically difficult to realize due to variations in weather, ground and plant phenological conditions.

Thus, any underestimation of the amount of competition occurring, or anticipated to occur, on a particular site may result in an inhibition of crop species growth for one or more full growing seasons. Additionally, overtopped conifers may develop "shade tolerant" foliage; such a development normally results in a "lag" effect whereby the conifers cannot immediately respond (in terms of increased growth) to release. There appears to be a direct relationship between the intensity and duration of this shading and the potential "lag" effect. This effect not only extends the

rotation length but may also allow sufficient time for regrowth of weed species, necessitating further treatment. Weed control is normally more difficult (higher cost per unit area) to achieve in areas having severe competition problems, as well.

Stands that have experienced several years of weed suppression might be considered for release treatment, particularly when a herbicide program is being initiated for the first time. The condition of the crop species (ability to respond to release), the amount of survival (stocking of crop species), potential for fill-planting and size of area involved would, however, be important economic considerations. Such release treatments could conceivably occur at a variety of development stages of both the crop and weed species with the most extreme being removal of pole-sized hardwoods.

In view of these factors it is recommended that all sites be examined in late summer rather than spring (potential weed problems more evident then) to establish consistency in the decision-making process regarding herbicide treatment. Although specific management goals and resources will introduce variability into this process, anticipation of potential problems and prevention of these problems prior to inhibition of crop species growth should be advocated.

Refinement of criteria regarding herbicide usage may be accomplished through the development of strong feedback mechanisms to quantify the short-term and long-term benefits, in terms of weed species suppression and wood fiber production, associated with particular treatments. It is important that the response of

the crop species be quantified rather than just a determination made of the degree of suppression of the weed species, although the two are obviously related. Complete weed removal is normally unnecessary (particularly in release operations) and may be undesirable; what is ideally needed is a broad spectrum control of target, rather than non-target, species. Such quantification will ultimately result in improvements (e.g. greater specificity) to the decision-making process regarding herbicide use. This will be difficult to achieve due to the number of site-related variables involved, in addition to changes in the efficacy and availability of herbicides.

This has not really been accomplished for other, less recent forest management techniques. Herbicide treatment is unique in that it has received, and will continue to receive, a good deal of public attention relative to other forest management practices. If is is to remain as a management option it is imperative that long-term effects be identified and quantified in conjunction with increased education and understanding by both forest managers and the general public.

A reasonable methodology appears to be the development of functional crop species growth models that can be supplemented, revised and validated by statistically sound field testing. Examination of effects should include not only increases in wood volume production per unit area but also potential adverse effects, particularly nutrient loss and alteration of plant or microorganism community structure. Formulations and applications that produce drastic changes in community structure may result in the

profusion of species (e.g. fireweed) that were relatively uncommon prior to treatment; the effect of these new species must be addressed.

Future refinements in site classification should be encouraged with respect to improving the predictive capability in identification of potential weed problem sites. The establishment of significant correlations between indicator species and/or number of species, before or after disturbance, and identification of such problem sites may be possible.

The heterogeneous nature of most potential treatment sites precludes definitive, elaborate measurement in the development of competition indices, particularly on typical operational programs. However, coordinated education and information updating, based on the above-mentioned research, may increase the uniformity of the decision-making process.

Research on seedlings relative to maximum sustainable levels of competition while still maintaining maximum growth and duration of the "lag" effect produced by varying levels (intensity and duration) of suppression needs attention. The results of such research, while varying by type and condition of seedling, will influence future management decisions.

Refinements in the technology of application, such as alterations in adjuvants, droplet size and timing, may result in more cost efficient operations. Increased efficacy will reduce the potential for retreatment and subsequently affect management decisions. Development of a methodology to lengthen the time period for release treatments may be possible through research, as well.

PART II

HERBICIDE APPLICATION

The following discussion will pertain to both aerial and ground herbicide application programs. The emphasis will, however, be on aerial application due to its more widespread current and predicted usage. It is suggested that ground applicators consider appropriate modifications of the material presented, where necessary. Treatment of individual trees has been excluded. The extreme variability in the equipment and methodology associated with the application of herbicides, particularly ground application, negates complete inclusion in a manual of this nature. An inherent "generality" has been maintained; this will necessitate a selection of those portions deemed necessary for a specific operation.

AERIAL-GROUND APPLICATION

Aerial Application

Aerial application is the most cost efficient method of large scale herbicide application. A large area can be uniformly treated over a relatively short period of time with little input of manpower. There is no ground disturbance and, apart from mixing and loading, worker exposure to the chemical can be minimized. Road requirements may be reduced.

There are, however, some drawbacks to aerial applications. Capital investment may be prohibitively high if contract applicators are not available, particularly for small scale operations. Steep slopes and rough terrain may result in varying swath widths due to the influence of topography on spray deposition. On some areas devoid of identifiable landmarks uniform spacing of swaths may be difficult, even with a spotter aircraft. To ensure adequate coverage some overlap of spray swaths is normally practised. Areas having obstructions (such as residual trees and powerlines) and small and/or irregularly shaped areas are relatively difficult to treat with aerial applications.

To minimize the incidence of drift (lateral displacement of spray droplets away from a target swath or area) and volatilization losses, application should only take place during proper weather conditions. Aerial applications conducted by the New Brunswick Department of Natural Resources are currently terminated when wind speed (depends upon site exposure and amount of gusting) reaches 11 to 13 km/hr. (7 to 8 mi./hr.) and when the temperature reaches 21 to 24°C (70 to 75°F). As a result, aerial spraying is

normally confined to early mornings and evenings. Spray droplets may be carried upward by rising air currents. Drift is accentuated under conditions of rapid warming (strong lapse; air warmest at ground level with gradual cooling at higher elevations), when an inversion layer (cool air at ground level with gradual warming to a certain height at which it again becomes cooler) is present and in conditions of high humidity. Evening operations should not commence until the temperature at ground level begins to drop. The height of release has an important influence on drift. In New Brunswick this release height is normally 23 m (75 ft.) or less above ground; greater heights may increase swath widths and the safety margin but may enhance drift and produce non-uniform coverage. Conformance to the above-mentioned weather conditions will vary in part with the expected volatilization losses. These losses are a function of the particular characteristics of the formulation being sprayed, the temperature and relative humidity (minimum losses during periods of relatively low temperature and high humidity) and the size and velocity of droplets.

Helicopters offer several advantages over fixed-wing aircraft. Relatively small areas can be treated more effectively and operations can safely take place closer to the adjacent canopy than with fixed-wing aircraft. Helicopters can generally be landed closer to the treatment area, substantially reducing the ferrying time for more fuel and/or chemical mixture; this is especially important when application time is limited. It also appears that there are more drift control modifications available for helicopter-mounted equipment than for fixed-wing (such as

Microfoil[1] booms), in the event that such equipment is deemed to be economically justifiable.

The size of aircraft used is influenced by the payload desired, manouverability required to carry out the operation and availability. In general, larger machines have greater payload capacity but reduced manouverability. The boom and nozzle system is by far the most commonly used in aerial applications. Various rotating devices (rotary atomizers), in which the formulation to be dispersed is fed into discs rotating at high speed, have seen limited application and will not be discussed further.

The number per unit area and size [normally expressed as volume mean diameter (VMD)] of droplets of spray are important factors in the effectiveness of any herbicide program. The optimum values will vary with the type of herbicide formulation being used and, to a certain extent, with the particular situation. Droplets of foliage sprays are ideally small and closely spaced; however, if droplets are too small they are susceptible to drift and vaporization. A range of 500 to 800 microns for foliage spray droplets is considered to be appropriate in New Brunswick; the incidence of drift may increase below the 300 to 350 micron range. Larger size droplets may be necessary for the aerial application of root uptake herbicides. However, no root uptake herbicides are currently registered for aerial use in New Brunswick.

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[1] Microfoil is a registered trademark of Union Carbide Corporation

Although there will always be droplets outside of the optimum range, good results can be achieved through combination of the pressure of the system [normally 1.4 to 2.1 kg/cm^2 (20.0 to 30.0 lb./in.^{2})], nozzle size and orientation (the greater the wind resistance the smaller the droplet). In New Brunswick, conventional cone nozzles with D-8 or D-10 orifices and number 45 or 46 swirl plates are typically used. Nozzles are normally oriented downward or to the back of the aircraft. They should never be oriented forward at less than 45° because some formulation will collect on them, resulting in corrosion and wastage through large drop formation. Additives to the spray mixture, such as particulating and thickening agents, can be used to modify the degree of cohesion of individual droplets and, consequently, mean droplet size.

Normal aerial spray volumes range from 18.6 L/ha (2.0 U.S. gal./ac.) to 93.2 L/ha (10.0 U.S. gal./ac.) of total spray mixture, depending upon the stratification of the target vegetation (e.g. if 2 layers are present a greater volume per unit area is required) and financial constraints. The amount of active ingredient applied is considerably lower than the aforementioned values and varies with the type and phenology of both the crop and target species, time of year and financial constraints. Recommended application rates are included in the discussion of each herbicide.

Prior to herbicide application the aircraft and attached spray system must be calibrated to ensure that the recommended spray volume is being emitted and that coverage (swath width) and

mean droplet size are adequate. This calibration is carried out by simulating an application flight using water and dye in place of herbicide. If a helicopter is being used, calibration of the output rate (but not coverage or mean droplet size) can be accomplished on the ground, provided the engine is operating at spraying speed. Each system must be individually tested due to variation in the pumping mechanism, operational boom pressure and wind resistance and wake characteristics (affecting deposition of the droplets). Corrections can be made by altering the air speed, boom pressure, flying height and number, location and type of nozzles. Air speeds normally range from 113 to 129 km/hr. (70 to 80 mi./hr.) for helicopters and 145 to 161 km/hr. (90 to 100 mi./hr.) for fixed-wing aircraft.

Ground Application

Ground application of herbicides is obviously most advantageous when the total area to be treated is small and/or irregular in shape and a large scale aerial program cannot be justified. It is more labour-intensive than aerial application. There may be less risk of environmental problems due to the smaller size of treated areas and lower height of chemical release (less potential for drift). Due to this lower release height, a smaller mean droplet size may be used. As with aerial applications, various equipment modifications and chemical additives can reduce the incidence of drift.

Worker exposure is increased. Uniform coverage is more difficult to achieve with ground application methods unless the spray apparatus can be located directly over the target species, such as a spray boom and nozzle system mounted on a tractor over relatively low vegetation. Uneven or rough terrain enhances this difficulty. For this reason detailed calibration of ground application equipment is not common in New Brunswick. There is also a greater potential for ground disturbance and damage to the seedlings of crop species with ground application. As with aerial application, adverse weather conditions (winds, high temperature, rising air currents) can reduce the effectiveness of the program.

There are a variety of ground application methods. Ground application equipment may be either hand-held or machine-mounted and may be in the form of mist blowers or hydraulic sprayers (boom and nozzle systems, cluster sprayers, pressure hoses, etc.). Although none are currently registered for use in New Brunswick,

dispersion of dry formulation (pellets, granules, etc.) root-uptake herbicides could be carried out either by hand or with machinery and might be particularly cost effective if combined with site preparation equipment. Drift problems would also be eliminated with the application of such dry formulations.

Mist blowers generally produce more fine droplets and better coverage than hydraulic sprayers and these may be advantageous in areas where height of the crop species trees restricts vehicular access. However, drift and worker exposure problems may be greater. Hydraulic sprayers permit greater flexibility in the method of application.

To ensure adequate coverage, the total spray volume per unit area is normally higher with ground application than with aerial application. However, the amount of active ingredient per unit area is similar, resulting in a less concentrated spray mixture. Total spray volumes associated with machine-mounted equipment range from 280 L/ha (30 U.S. gal./ac.) to greater than 699 L/ha (75 U.S. gal./ac.). Normal spray volumes for hand-held equipment range from 93 L/ha (10 U.S. gal./ac.) to 233 L/ha (25 U.S. gal./ac.). Due to the variety of ground application equipment, pressures are extremely variable; however, they are generally much higher than for aerial application equipment.

HERBICIDES

A brief summary of the characteristics and efficacy of the herbicides currently registered and available for forestry use in New Brunswick is herewith presented. This is intended only as an aid in the selection of a particular herbicide; users must consult the "label" associated with each herbicide for specific instructions. The "label" is a legal document, binding on both the user and the manufacturer. Selection should involve not only the initial cost of the herbicide but also its predicted effectiveness and the subsequent necessity of additional treatments.

Herbicides must be registered under the Pest Control Products Act, which is administered by Agriculture Canada, and be approved by provincial environment and health departments before they can legally be used in forestry operations. The registration process is elaborate; the manufacturer must submit data regarding the use, toxicity, storage, disposal and both short-term and long-term effects to Agriculture Canada. This material is then scrutinized by Agriculture Canada, Health and Welfare Canada, Fisheries and Oceans Canada, Environmental Protection Service, Canadian Wildlife Service and Canadian Forestry Service. This understandably involves a considerable amount of time (in the order of years) and money. The manufacturer may be asked to provide additional data in the event that inadequacies are identified. Registration approval is accompanied by specifications such as the type of use, target species, directions for use and precautions.

Roundup

Roundup[2] is a broad spectrum herbicide that is registered for both aerial and ground usage. It is sold as a water soluble liquid of which 41.0% (by weight) is active ingredient, the isopropylamine salt of glyphosate [N-(phosphonomethyl) glycine]. The remaining 59.0% consists of inert ingredients, such as surfactants (to facilitate absorption into the plant tissue) and other adjuvants. It can be stored for at least 4 years.

It is a foliar spray and translocates readily in plants with little damage to the translocating tissues. It is very immobile in the soil (resulting in little leaching or lateral movement), being rapidly adsorbed by soil particles. Roundup has been found to degrade relatively quickly in the soil into carbon dioxide, water, nitrogen and phosphate, largely through microbial action. There is no root uptake activity; it enters plants entirely through foliage absorption. Roundup appears to inhibit the synthesis of an essential amino acid, phenylalanine. Bioaccumulation rates in animals have been found to be low, at least partially due to its low oil solubility. It dissipates rapidly in static water.

Roundup appears to be useful for both site preparation and for release of previously established crop species. In site preparation work, planting can occur soon after the application due to its high biodegradability and lack of residual activity. Spring applications are generally conducted for removal of herbs

[2] Roundup is a registered trademark of Monsanto Agricultural Products Company

while late summer-fall applications are most effective against woody species. It is particularly effective on deciduous shrubs and hardwoods when applied in late summer or fall and translocation to the root systems can occur prior to leaf fall. In New Brunswick its usage has largely been restricted to late summer or fall applications (end of July to the first killing frost) following plantation establishment. For maximum effectiveness, application should be delayed for at least one year after soil disturbance (as disturbance often produces competing vegetation).

Applications of 4.66 L/ha (0.5 U.S. gal./ac.) to 9.32 L/ha (1.0 U.S. gal./ac.) of Roundup have been shown to provide good control of most perennials, particularly raspberry and aspen, as well as grasses. Red and sugar maple show some resistance. In New Brunswick an average rate of 4.66 L/ha (0.5 U.S. gal./ac.) of Roundup has been used, depending on the type and phenology of both the crop and target species as well as financial constraints. As Roundup is relatively expensive, application of the minimum amounts required to achieve the desired results should be encouraged. However, any tendency to reduce concentrations should be tempered by the possibility of having to re-spray the area (due to insufficient kill the first time). As with any foliar herbicide, excessive concentrations can cause leaf "burn", resulting in poor translocation to the lower stem and root system. The crop species may also be damaged.

Roundup should not be applied within 6 hours before rainfall as it is a water soluble foliar spray. Applications conducted after a rainfall should be delayed until the water has ceased to

drip from the target species foliage. It has very low volatility; applicators must therefore be certain that the entire area is treated as no vapor is created which could kill "missed" vegetation.

Roundup should not be stored or mixed in galvanized steel tanks as it is corrosive to mild steel, galvanized steel and zinc; it produces hydrogen gas, possibly resulting in a highly combustible gas mixture. The water to be used in the application process should be tested before mixing; as the glyphosate has been reacted with a base (amine) to form a salt, it can be neutralized in muddy or high organic content water. Water should be added to the mixing tank first, followed by Roundup and then more water. Agitation is then carried out; an antifoam agent may be necessary. Without agitation the Roundup formulation will form a layer on the bottom of the tank.

Roundup will cause irritation to the skin and eyes following contact. A long sleeved shirt, long pants, rubber or plastic gloves and splash goggles are recommended when handling it. In the event of skin contact the exposed area should be thoroughly washed. Respiratory protection is not required. Equipment can be cleaned with a thorough flushing of water.

Esteron 600 and For-Ester EC

Esteron[3] 600 and For-Ester[4] EC are herbicides currently registered for both aerial and ground usage that contain long-chain alkyl esters of 2,4-D (2,4-dichlorophenoxyacetic acid) as the active ingredient [600 and 500 g/L (5.0 and 4.2 lb./U.S. gal.) of product, respectively]. Both are sold as low-volatile ester emulsifiable concentrates; they can be stored under normal conditions for 3 years. The ester form of 2,4-D is an organic solvent and is oil soluble. The products contain a mixture of 2,4-D and oil, in addition to emulsifiers and other additives; when mixed with water prior to application the oil droplets become dispersed in the water, producing a milky emulsion. Continuous agitation is necessary. In the mixing process half the required amount of water should be added to the mixing tank first, followed by the herbicide and then the rest of the water. Mixtures involving only oil as carriers are not common and therefore will not be discussed here.

These are largely foliar sprays although they have some ability to soak through bark, particularly near the tips of plants. Due to the oil solubility they do not wash off foliage readily. Being one of the phenoxy herbicides, 2,4-D produces abnormal growth responses in plants as well as affecting the respiratory system. Once absorbed via the foliage or bark it must be translocated to specific sites of activity; there is also normally some

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[3] Esteron is a registered trademark of The Dow Chemical Company

[4] For-Ester is a registered trademark of Later Chemical Company

deposition in the cambium, roots and storage tissues. Excessive concentration of chemical and too rapid invasion of leafy tissues, resulting in leaf "burn" and subsequently poor translocation, must be avoided.

There is no root uptake or residual activity associated with this chemical. Mobility is inhibited in highly organic and low pH soils (although some leaching of the salt form of 2,4-D may occur in sandy soil) and microbial decomposition normally results in low persistence in the soil (depending upon temperature, moisture, organic matter content, etc.). Hydrolysis of the ester form of 2,4-D into either the salt or acid form is normally rapid. These latter forms are less volatile than the ester form; therefore volatilization problems are usually short-lived. Nevertheless, applicators should be aware of the volatile nature of esters of 2,4-D, particularly in association with "drift" problems.

Bioaccumulation rates of 2,4-D in animals are greater than for water soluble chemicals but these are reported to still be generally low, with rapid excretion and brief residence time once exposure ceases.

The herbicide 2,4-D can be used for both site preparation and release of softwoods. Applications ranging from 2.2 to 3.4 kg/ha (2.0 to 3.0 lb./ac.) of active ingredient have been found to be satisfactory against willow, alder, birch and pin cherry. However, the use of 2,4-D appears to be quite limited in New Brunswick as it is ineffective in controlling raspberry, grasses, sedges, ferns, aspen and maple. An inherent problem with its use is that this selective effectiveness (e.g. against alder) may

provide an opening for other non-susceptible, but potentially more problematic, "weed" species (e.g. raspberry), thereby magnifying the problem rather than relieving it. The height of the crop species and its ability to respond to the newly created openings are obviously important factors in such a situation.

When 2,4-D is used in combination with another phenoxy herbicide, 2,4,5-T, a broader spectrum of control can be achieved. Although the use of 2,4,5-T containing less than 1 ppm (part per million) of a highly toxic dioxin impurity (2,3,7,8-tetrachlorodibenzo-p-dioxin, commonly known as 2,3,7,8-TCDD) is permitted in New Brunswick, this herbicide is generally unavailable due to a stoppage in production.

Alcohol or ketone type solvents should be used to clean equipment. Skin or eye irritation may result from direct contact with this herbicide.

Garlon 3A and Garlon 4

The herbicides Garlon[5] 3A and Garlon 4 are currently not registered for use in Canada. However, Garlon 4 may soon be registered (within the next two or three years) for both ground and aerial usage. Triclopyr, [(3,5,6-trichloro-2-pyridinyl) oxy] acetic acid, is the active ingredient in both liquid formulations. Garlon 4 is sold as an emulsifiable concentrate containing a low-volatile ester of triclopyr [480 g/L (4.0 lb./U.S. gal.) of active ingredient] while Garlon 3A is sold as a water soluble liquid containing an amine salt of triclopyr [360 g/L (3.0 lb./U.S. gal.) of active ingredient]. The amine formulation is less volatile than the ester formulation. However, leaf penetration is better with the ester formulation; the addition of an agricultural surfactant to the amine spray mixture is recommended by the manufacturer. Both formulations can be stored under normal conditions for at least 2 years.

These are primarily foliar herbicides (possibly some bark penetration with the ester formulation). Triclopyr is translocated within the plant, with accumulation in meristematic tissue. The mode of action appears similar to that of 2,4-D. The efficacy of both formulations in site preparation and conifer release work is similar although the ester formulation appears to be more effective on raspberry than the amine. Rates of 2.2 to 4.5 kg/ha (2.0 to 4.0 lb./ac.) of active ingredient have been shown to be effective on a wide range of woody plants, such as alder, maple,

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[5] Garlon is a registered trademark of The Dow Chemical Company

pin cherry, aspen, birch and raspberry. Neither Garlon formulation is as effective on raspberry and aspen as is Roundup, and both are ineffective on grasses. However, they are more effective on maple. Plantations having heavy red maple competition may therefore be more efficiently treated with an application of Garlon. Garlon 4 may be more advantageous than Roundup when rain is imminent, due to the oil solubility and subsequent greater foliar absorption quality of the active ingredient (no application within 4 hours of rain is suggested). As with other foliar herbicides, release work must be postponed until late in the growing season when the crop species has "hardened-off"; site preparation work can be effectively carried out early in the growing season.

Triclopyr is relatively mobile in the soil as it is not adsorbed by soil particles, resulting in some root uptake and possible leaching (particularly in light, porous soils). However, persistence in the soil is normally low. The ester form of triclopyr rapidly converts to triclopyr acid upon contact with water or soil; this acid is normally neutralized to form a salt. This salt form of triclopyr is reported to be readily degraded by sunlight and microorganisms (microbial degradation best on relatively warm, moist soils).

Mixtures of triclopyr with either glyphosate or 2,4-D appear to have good potential (particularly the combination of triclopyr and glyphosate) for a broad spectrum of weed species control with smaller total amounts of herbicide needed. Further evaluation is needed for both site preparation and conifer release work. The utilization of such mixtures is, however, contingent upon obtaining research permit approval.

The following sequence should be utilized in mixing Garlon herbicides; water is added to the mixing tank first, then any surfactants, emulsifiers or anti-drift agents, then any other herbicides and then the Garlon. Continuous mild agitation is necessary. Mixtures involving only oil (for the ester formulation) are uncommon. Equipment should be washed with detergent and rinsed with water after use.

Garlon 3A is not absorbed through the skin but can result in skin and eye irritation. Garlon 4 is essentially non-irritating to the eyes but is slightly irritating to the skin. Exposed skin should be washed in flowing water. Any vapors should not be inhaled; respiratory protection is advisable.

Velpar L

Velpar[6] L is currently registered for ground usage as a site preparation herbicide; it is sold as a water soluble liquid containing 240 g/L (2.0 lb./U.S. gal.) of the active ingredient, hexazinone [3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione]. Inert ingredients comprise the remainder of the marketed formulation. It can be stored under normal conditions for at least 2 years and is relatively non-volatile.

Absorption of hexazinone occurs mainly through plant roots, although there may be some foliar uptake as well. It is quite soluble in water and requires moisture to be dispersed into the soil to the root zone of the target species; best results are normally found on warm, moist soils which receive 0.6 to 1.3 cm (0.25 to 0.5 in.) of rainfall within 2 weeks following application. The majority of the translocation is upward through the xylem. Hexazinone appears to act as a photosynthetic inhibitor (may also affect nitrogen metabolism) and is effective in controlling grasses, other herbaceous weeds, raspberry and aspen. Application rates of 2.2 to 4.5 kg/ha (2.0 to 4.0 lb./ac.) of active ingredient have been used in New Brunswick. Because it is a root uptake herbicide, soil characteristics (texture, organic matter content, moisture) will have an important influence on overall results.

Hexazinone does not persist in the soil for a long time (half-life varies from 1 to 6 months, depending on soil and

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[6] Velpar is a registered trademark of E.I. duPont de Nemours and Company

climate) and is only moderately adsorbed to soil particles. Dissipation is primarily via microbial degradation, which is most rapid under warm, moist soil conditions. Leaching occurs in sandy, low organic matter content soils. Injury to conifers is possible on such porous soils, so low rates should be used. Higher rates of application may be necessary on soils having higher concentrations of organic matter, clay or silt. Low and high rates of 1.1 to 2.2 kg/ha (1.0 to 2.0 lb./ac.) and 2.2 to 3.3 kg/ha (2.0 to 3.0 lb./ac.), respectively, are suggested by the manufacturer.

Spring applications of Velpar L appear to be the most advantageous. Treatment should be timed well before softwood bud break or planting as both spruce and jack pine may be susceptible to injury if applications take place while they are actively growing.

Preparation of the spray mixture requires that the water be added to the mixing tank first, followed by the required amount of Velpar L and then a surfactant, if desired. The mixture is then thoroughly agitated. If an antifoam agent is needed it should then be added; this is followed by agitation. The solubility of Velpar L in water varies with the water temperature. At least 5 gallons of water should be used for every gallon of Velpar; this presents no difficulty in the normally higher total volume ground spray applications.

Hexazinone is regarded as irritating to the eyes but non-irritating to the skin. Exposed areas should be flushed thoroughly with water. Applicators should avoid breathing the spray mist. Spray equipment should be cleaned with several changes of water.

Miscellaneous Ground Application Herbicides

Several herbicides are registered for ground application control of grasses and other herbs. Their main forestry related usage is in the production of Christmas trees. However, they have received limited use in the establishment of conifers on old field sites and so will be briefly discussed.

Simazine [2-chloro-4,6-bis(ethylamino)-s-triazine] is the active ingredient in Princep[7] Nine-T, Princep 4G, Princep 80W, Simadex[8] 80W, Simadex FL and Simazine[9] 80. It can be applied in either a granular or liquid form. Constant agitation is necessary for suspensions.

Simazine is a pre-emergence (soil sterilization) herbicide and should be applied prior to weed growth. Satisfactory results are normally produced with early spring applications, although fall applications are also carried out. It inhibits the photosynthetic process and is most effective on grasses. Conifers are relatively tolerant of simazine, although some injury can occur at high dosages; it appears that some proteins of conifers can chemically react with the herbicide, producing biologically inactive combinations. Effectiveness depends upon absorption by the plant roots; it requires rainfall or soil disturbance to move it into the root zone. Simazine appears to be inactivated by the organic duff layer on cutover sites and so is only useful in old field

[7] Princep is a registered trademark of Ciba-Geigy Corporation

[8] Simadex is a registered trademark of F.B.C. Chemicals Canada Inc.

[9] Simazine is a registered trademark of Solcoor Canada Ltd.

situations. It is reported to have negligible mobility in the soil. Rates of 4.0 to 6.5 kg/ha (3.6 to 5.8 lb./ac.) of active ingredient are suggested for applications in New Brunswick. However, when a spring application is to be followed by summer planting of container stock, rates of 2.0 to 3.0 kg/ha (1.8 to 2.7 lb./ac.) of active ingredient may be advisable. In general, the lower rates should be applied on porous, low organic matter content soil. If used in a pre-planting treatment, planting should not take place for at least 3 weeks. Post-planting treatments can occur anytime after planting but conifer seedlings should be dormant or "hardened-off".

A broader spectrum of weed species control may be realized by using a mixture of simazine and glyphosate.

Amizine[10] is a herbicide which contains a mixture of simazine and amitrole. It is sold as a wettable powder or a liquid, both of which form a suspension in water, requiring constant agitation. An application rate approximating 7.9 kg/ha (7.0 lb./ac.) is suggested by the manufacturer. Amitrole is normally slowly absorbed via the plant foliage, although there may also be some root uptake, and is readily translocated. It inhibits the synthesis of chlorophyll and new shoot growth. Previously established conifers may be susceptible to damage, particularly if they have not "hardened-off".

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[10]Amizine is a registered trademark of Union Carbide Corporation

Asulox[11] F is a herbicide which is largely used for control of bracken ferns. Asulam is the active ingredient; it is readily absorbed through the foliage (absorption can be enhanced with the addition of a surfactant) and roots. It is translocated to the meristematic regions of the plant where it appears to interfere with plant growth. Application rates vary from 1.1 to 7.5 kg/ha (1.0 to 6.7 lb./ac.) of active ingredient.

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[11]Asulox is a registered trademark of Rhône-Poulenc Inc.

APPLICATION PROCEDURE

Preliminary

Certification and Licensing

The New Brunswick Pesticides Control Act, and regulations therein, specifies the variety of certificates required of pesticide applicators. Three classes are pertinent to forestry operations; Class "A" certificates authorize aerial application while Class "B" and "C" certificates authorize ground application. Various levels within each class denote certification of different job functions (Appendix 1). Certification is obtained from the Pesticides Advisory Board following formal request (Appendix 2) and scrutiny of each request. Approval is largely a function of competence, training and experience, and varies with the level of certificate required. To date there are no formal training programs in New Brunswick pertaining exclusively to the application of pesticides. An analogous process is necessitated in the procurement of a Pesticide Operator's Licence and a Vendor's Licence (Appendices 3 and 4, respectively). All certificates and licenses are subject to renewal on a yearly basis (Appendix 5). Holders of Pesticide Operator's Licenses are required to record and submit yearly to the Director of Pesticides Control (Department of the Environment) information pertaining to the application of pesticides (Appendix 6) while holders of Pesticide Vendor's Licenses are required to submit information on the sale of all pesticides classified as "Commercial" or "Restricted" under the Federal Pest Control Products Act (Appendices 7 and 8, respectively). Informa-

tion regarding the premises of pesticide storage must also be provided to local authorities (Appendix 9).

Application Permits

All aerial pesticide applications require a permit issued from the Department of the Environment. The request for this permit (Appendix 10) must include the name of certified applicator and licenced operator (if applicable), a description of the application equipment (e.g. type of aircraft and boom-nozzle system), proposed timing of operation, location and size of areas to be treated (maps may be required), formulations to be used and their concentrations, and methodology of container disposal. Ground applications carried out by certified applicators on their own land do not require a permit. A permit is required for all other ground applications (Appendix 11). The granting of a permit is usually accompanied by several conditions, including establishment of specified setbacks and buffer zones (varies with pesticide being used), enacting specified precautionary measures and submission of a final report to the Chairman of the Pesticides Advisory Board. An "Order" (Appendix 12) may be issued at any time by the Department of the Environment, halting any or all facets of a particular operation. This decision can be appealed (Appendix 13) by the applicator.

Tenders and Contracts

Tenders will normally be invited for herbicide application contracts; a project description outlining objectives and desired procedures should be included. All contracts should be written out and signed by the parties involved. Equipment and manpower

needs should be clearly delineated. For example, an aerial application contract should deal with the number of aircraft and pilots needed (including specifications and qualifications), the application equipment, backup units and staff, supplies (fuel, food, etc.), arrangement for reconnaissance flights or guidance aircraft and responsibility for transportation and mixing of the herbicide formulations. The time frame, areas to be treated (maps and aerial photographs), specific herbicide formulations (including adjuvants), application rates, flying height, swath width, air speed and proper weather conditions for application should be established. It may be necessary to have weather recording instruments, such as anemometers and sling psychrometers, available on site. Calibration of equipment, normally with water and dye, should take place in conjunction with these requirements. Provisions for incompleted work, jettisoned loads or missed swaths should be discussed. The hiring person or agency will normally have the final decision regarding the initiation and termination of a particular operation, subject to the discretion of the pilot (i.e. if a situation is considered to be unsafe). Adequate insurance policies (to cover workmen compensation, public liability and property damage) and the terms of liability must be established prior to commencement of operations. A camera should be available on site to aid in documentation of noteworthy events (e.g. spills, accidents).

Reporting System

The pertinent information of every herbicide program should be recorded via a uniform reporting system. This would include

any pre-treatment data collection, timing of application, formulation and rate used, methodology of application, location and size of area treated and weather conditions (wind speed and direction, air temperature, relative humidity, dew on foliage, occurrence of rain). The actual design of this reporting system will vary with the type of application (e.g. aerial vs ground application). The New Brunswick Department of Natural Resources currently utilizes a "Load Record" form during aerial application of herbicides (Appendix 14) and prepares a summary upon completion of each treatment area. A field "check-list" delineating all equipment and manpower needed for a successful operation, as well as the sequential steps, could be incorporated into this reporting system framework.

Staff Training

All supervisory staff should be designated prior to commencement of operations. This staff will be responsible for ensuring that each operation is carried out satisfactorily, the reporting system is adhered to, safety regulations are conformed to and appropriate emergency measures, if necessary, are taken. The size of staff required will be largely dependent upon the magnitude and type of operation.

All personnel involved in the application of herbicides should be properly trained and periodically evaluated. They should be aware of the objectives of the operation, their daily routine, potential hazards and proper handling techniques. They should never work alone. They should be instructed in how to properly deal with the general public, if necessary. Reading and understanding the "label" associated with each herbicide is very

important, as is knowing the current regulations governing the transportation, mixing and usage of that particular formulation. Contingency plans in the event of a spill (Appendix 15), accident or fire should be well versed. All staff members should know how to administer first aid, specifically the type of treatment recommended for exposure to the particular chemicals in use. Emergency washing stations, fire extinguishers and first aid kits should be available on site. In addition to the standard items, first aid kits should contain common detergent (for washing exposed skin), salt (added to water to induce vomiting), neutralizing agents for swallowed chemicals (baking soda or milk of magnesia for acidic chemicals and lemon juice or vinegar for basic or alkaline chemicals), activated charcoal (absorbs swallowed pesticides when ingested with water), a shaped plastic airway, clean water, a clean blanket, an empty jar (for ingestion of above mentioned materials) and a quarter (for an emergency phone call). Local hospitals or poison control centres should be informed of the chemicals in use and requested to have antidotes on hand. If possible, a good communications system should be established with such institutions.

Staff Equipment and Clothing

The equipment and clothing required by personnel directly involved with the application procedure (i.e. some risk of chemical exposure) will depend upon the specific formulation being used (variable penetration characteristics and toxicity) so it is extremely important to read all "labels". Regulations of the New Brunswick Occupational Health and Safety Act and Industrial Safety

Code must be conformed to. Personnel should have access to approved masks or respirators and goggles, face shields or other approved eye protection. Ear protection may also be required. Liquid-proof neoprene or rubber gloves are necessary, as are steel-toed boots (preferably rubber or equipped with neoprene pullovers). Long-sleeved shirts and long-legged trousers or coveralls should be worn outside of these. A liquid-proof raincoat or apron may be substituted for the trousers or coveralls. Disposable coveralls are becoming popular. A liquid-proof, wide-brimmed hat should also be worn, preferably without a cloth or leather sweatband which could absorb chemicals. Contaminated clothing should be removed immediately and cleaned separately or destroyed if complete cleaning is impossible. All clothing should be cleaned on a daily basis, regardless of the level of contamination. Proper facilities for this cleaning and for storage of clean clothing must be available.

Mixing-Loading

The mixing-loading unit should be portable and all tanks accurately calibrated and clean. Apart from small scale ground applications, herbicide operations are normally more efficient if mixing takes place in tanks not associated with the dispersal equipment; new "batches" can be prepared concurrently with the actual application procedure, saving valuable time. Pilots should never participate in the mixing-loading process.

All herbicide formulation mixing should occur outdoors. Measuring sticks, bung wrenches and battery-powered calculators are normally valuable, as are clearly visible and legible charts

indicating concentrations and volumes. Efficient, high-output centrifugal pumps and chemical resistant hose are necessary for mixing, agitation and loading. Positive shutoff valves and pump combinations are used to control flow rates. If circulation mixing is utilized it is most advantageous to attach the return line near the bottom of the tank as this tends to "wash" the tank bottom and reduce potential of foaming. If wettable powders are being used, cylindrical or oval tanks with large top openings are best.

Filters or strainers may be required during loading and when water from a watercourse is being added to the mixing tank. In the latter case a device to prevent backflow of the formulation into the watercourse should always be installed. A pH tester may be useful when adding water. All paper bags should be opened with a knife rather than torn open. Containers should be used to collect any material leaked from the mixing-loading apparatus during valve or other equipment adjustment. Equipment for lifting heavy containers of herbicide or adjuvants may be required.

Dispersal Equipment - Aerial Application

The strength of aircraft spray tanks may be increased by the installment of baffles inside the tanks. This will also reduce "sloshing" of the formulation. The shape of the tank should be such that it will completely drain. Air vents, gages and screens are required in aerial applications. Any air trapped in the boom can be eliminated via tees and bleed lines. The pumping mechanism must be calibrated for the particular boom system. Good radio communication between the aircraft and the mixing-loading site greatly increases the efficiency of the operation.

Treatment Area Delineation

All areas scheduled for herbicide treatment should be examined prior to operation commencement to identify any obstructions, such as snags or powerlines, and accessibility. This examination could be incorporated with pre-treatment data collection or as part of the decision process in establishment of priority treatment areas. Watercourses, water supplies, recreational areas, areas of unique ecological value, nearby dwellings and any other pertinent features in or near treatment areas should be identified and protected with sufficient buffer zones. This may require input from staff of the Department of Natural Resources and the Department of the Environment. The New Brunswick Pesticides Advisory Board currently stipulates that no aerial herbicide application is to take place within 65 m (213 ft.) of open surface water and 3.2 km (2 mi.) of the point of extraction of any municipal surface drinking water supply. It should be noted that the various adjuvants (e.g. surfactants) included in the herbicide formulation may be more damaging to the aquatic ecosystem than the active ingredient itself.

If aerial application is to take place, an airstrip or heliport site must be located or constructed. To reduce non-productive ferry time this should be as close as possible to the treatment area. However, this decision will be tempered by the distribution of other areas to be treated (i.e. one airstrip or heliport site servicing several treatment areas). Construction can be most efficiently undertaken during road construction (normally prior to harvesting), if future herbicide treatment is anticipated. The

specifications will vary with the type of aircraft being used; ultimate acceptability rests with the pilot(s). Calcium or water may be used to reduce dust problems.

The mixing-loading site should have relatively easy access to a supply of water to be used for mixing (via pumping or within easy hauling distance) but should be located such that accidental spills will not drain into any type of watercourse. The site should be accessible to heavy vehicles, well posted (warning signs) and gated to control trespass by the general public. Dust control is desirable. In aerial applications the mixing-loading site should be located adjacent to the airstrip or heliport. The site should have ample amounts of absorbent material to aid in containment of spills. A washing facility, with a large supply of soap and water, and clean changes of protective clothing should also be available. Appropriate cleaning agents for equipment are also required. A communications system at the site is essential in the event of an emergency.

The actual area to be treated should be clearly delineated both on the ground and on maps or recent aerial photographs. Ground delineation of the treatment area and swaths may be accomplished through utilization of natural features (snags, rock formations, etc.), flagging, fluorescent streamers or beacon lights. Human flagmen are not permitted in New Brunswick aerial application projects. Spotter aircraft are particularly valuable during large scale aerial applications and can substantially reduce the amount of ground delineation required. The area to be treated must be secured; if appropriate, signs should be posted. The

general public, woods workers in adjacent blocks and any other non-authorized personnel should be warned of the impending treatment and excluded during the spraying operation. Notification immediately prior to commencement of operations is normally required by the Department of the Environment; this will be specified in the conditions accompanying the permit approval.

Flight lines should be lengthwise within spray blocks to reduce the number of turns, but should avoid an east-west orientation due to glare from the sun. Flights perpendicular to the prevailing wind direction are preferable, due to enhancement of overlap and uniformity of coverage. The best application method consists of parallel straight lines, back and forth across the area. Spray booms should be shut off at the end of each swath and the aircraft pulled up before the turn is attempted. This turn should be carried out in ample time to allow for slight course adjustments before the dispersal equipment is turned on for the next swath. Successive flight lines should always be upwind of preceding lines to avoid flying into spray particles suspended in the air. Where possible, areas adjacent to boundaries should be treated when there is little wind or when there is a light breeze moving away from the boundary. Spray booms should be shut off in ample time to avoid buffer zones or obstructions to the aircraft. To obtain complete coverage it may be desirable to fly parallel to some types of obstructions (e.g. powerlines) following completion of the standard flight lines. In areas where steep or rugged terrain negates such uniform (attitude and speed) coverage it is normally advisable to have the flight lines follow the contours of

the slope. If this is also impossible application should only take place on downslope flight lines.

Spraying Operation

Transportation of herbicides to the mixing-loading site must be carried out with extreme caution, with containers secure and protected from damage. Precautionary measures must be taken to ensure that there is no danger of contamination of other commodities being transported at the same time. Drivers should refer to the "labels" and provincial regulations for specific transportation instructions and know what to do in the event of a spill or accident. Transportation vehicles should be equipped with the appropriate warning signs, clean-up equipment and equipment necessary for safely loading and unloading heavy containers (e.g. a high box and hydraulic tailgate). Containers will generally be transported in the back of trucks (never in the passenger compartment) and no passengers will be allowed to ride with the containers.

Prior to the scheduled treatment (usually the night before) a briefing should be held with all personnel to discuss daily assignments, areas to be treated (including unique features or problems), herbicide formulations, concentrations and emergency plans. Everyone involved with the operation should have read and fully understood the herbicide "label".

The first function on the morning of intended treatment is a check of both the current and forecasted weather; temperature, wind speed and direction, relative humidity, chance of rain and amount of dew on foliage. If conditions are favorable personnel should proceed to their assigned tasks. To make the best possible use of available spray time in aerial applications, both mixing

crews and pilots should be at the air base 0.5 to 1.0 hour before sunrise and flying should commence at first light.

A final check of equipment and supplies, including herbicide and adjuvants, immediately prior to commencement is essential. Delivery system specifications (e.g. number, type, location and orientation of nozzles) should be recorded and the calibration checked. Facets of the mixing, loading and agitation systems may require adjustment and these should be attended to. All tanks should be clean, particularly if a different formulation had been used in preceding operations. The area should be devoid of non-authorized personnel and appropriate warning signs posted. A quick review with the pilot(s) as to the exact areas to be treated, preferred dumping locations in the event of mechanical problems with the aircraft and flight paths between the mixing-loading site and the treatment areas (avoiding such things as inhabited areas and large bodies of water) is desirable.

If weather conditions continue to be favorable and no problems have been discovered, mixing and loading may commence. All dispersal equipment should be shut off prior to loading or refueling; smoking is not permitted. Mixing must be carried out according to previously established specifications; all partially empty containers should be properly resealed and the site kept tidy. All tanks, hoses, valves and dispersal equipment should be constantly checked for leaks or spills. If any problems are encountered the operation should immediately be stopped, the malfunction corrected and all spills properly attended to. The application rate should be periodically checked, through maintenance of an

accurate dispersal load record and observation, and appropriate corrections made. Once application equipment is calibrated any variation in its speed will affect the amount of herbicide applied per unit area while any variation in height (particularly in aerial applications) will affect uniformity of coverage.

The operation should be terminated or delayed if weather becomes unfavorable and/or drift (relatively easily seen from a spotter aircraft during aerial applications) or vaporization problems develop. Aerial applications are normally restricted to early morning and evening hours, so delay is common. For any delay a decision must be made regarding what to do with the formulation remaining in the dispersal and mixing apparatuses, as well as proper storage. This will obviously be largely influenced by the predicted length of delay. For aerial operations, dispersal of the remaining formulation in the aircraft, followed by dispersal of appropriate rinsings, is normally permitted while remaining formulation in the mixing tank is normally left there until conditions improve.

Upon completion of operations the dispersal and mixing-loading apparatuses should be thoroughly rinsed with the appropriate solvent (normally water) and these rinsings applied to the treatment area (e.g. last flight in aerial applications). More than one flushing may be necessary. The New Brunswick Department of the Environment stipulates that all empty containers be rinsed three times with the rinsings added to the spray mixture as part of the make-up water. This can be carried out during or at the completion of the operation, largely depending on the amount of

time available to the mixing-loading crew, but must be done before the empty containers are transported. After rinsing, containers should be punctured and/or crushed (to prevent future usage) and disposed of in approved solid waste disposal sites (Appendix 16) or buried under at least 51 cm (20 in.) of soil on private land (New Brunswick Department of the Environment should be notified). Allowance may be made for the recycling of large, rinsed containers by the manufacturers or other authorized agency.

Cleanup

All records, forms, daily logs and maps should be completed and/or updated, followed by review and certification by supervisors and applicators (e.g. pilots), at the end of each days operation. All equipment, containers and accessible valves should be locked up or otherwise secured and any necessary warning signs posted. The site should be cleaned up and all personnel properly washed. It is important to keep an accurate tally of empty herbicide and adjuvant containers; these should either be disposed of immediately or stored in a secure place until disposal. Subsequent operations can be planned and any additional material or manpower requirements satisfied. Prior to relocation to another site all equipment should be rinsed and cleaned and the current site cleaned up. It is important that all pilots and drivers have sufficient directions to the new site.

At the cessation of operations and completion of rinsing material application over the final treatment area, all equipment (pumps, hoses, valves, trucks, etc.) should be flushed and/or cleaned with an appropriate cleansing agent. Care must be taken to ensure that there are no "runoff" problems associated with this cleaning process. All materials, such as warning signs and boundary or swath markers, should be collected. All containers should be accounted for; any empty ones still on site should be properly disposed of. Records pertaining to the herbicide operation should be checked and any discrepancies addressed at this time; a discussion of the operation with all personnel involved may be advisable. This could include signed agreements with contractors,

involving such things as total area treated and number of working hours. Summarization reports may then be filed with the appropriate agencies, such as the Pesticides Advisory Board.

All unused herbicide or adjuvant material should be stored away from food or seed in tightly sealed, original containers and in an inaccessible or locked storage area. Unauthorized personnel should be denied access to this area. It should be well ventilated, cool, dry, delineated with warning signs and located so as to prevent watercourse contamination in the event of a spill. Construction of a dike or ditch around the storage area may be necessary. Absorbent materials (sawdust, lime, soda ash, soil, rags), wash-up facilities, protective clothing (stored such that it doesn't become contaminated), first aid kits and fire extinguishers are desirable at storage sites. "Labels" should be consulted for proper storage instructions (e.g. if freezing is harmful); all containers should be periodically examined for leaks, corrosion or other problems. An accurate, up-to-date inventory of the stored materials, including length of storage, should be kept. It is normally preferable to rotate the stock as much as possible, using the older material first. It may be advisable to inform local fire and health authorities as to the location of the storage area and the materials being stored.

Emergency procedures for herbicide spills are outlined by the New Brunswick Department of the Environment (Appendix 15); appropriate authorities must be contacted. If the spill is the result of an accident, rescue, first aid and transportation to advanced medical treatment have obvious priority. Containment of the spill

and prevention of further exposure are imperative. Although spills on dry land normally do not move very far, they should be barricaded or diked and covered with absorbent material or neutralizing agent (see "label" for most appropriate agent). They should not be allowed to drain into any type of water system. Dolomitic lime is preferable to soda ash on boggy land and where water contamination is likely. Soil and water samples may be required for analysis. In some cases it may be necessary to collect all contaminated material (including soil) in receptacles and bury it in an approved landfill site. All tools and clothing involved in the decontamination process should be cleaned.

Fires involving herbicides should be treated with extreme caution. Small fires may be controlled and extinguished by application personnel provided they can be attacked upwind from a safe distance, there is no danger of explosion and protective equipment is worn. Adjacent equipment and chemicals should be protected (e.g. cooled down). Foam and carbon dioxide should be used in fighting herbicide fires; if water is used precautions should be taken to prevent contaminated water runoff. Any herbicide spills or leaks must be given immediate attention. In the event of a major fire the fire department should be notified and provided with a complete list of the materials involved. The area downwind of the fire should be evacuated and provisions made for crowd control, if necessary. Appropriate authorities from the Department of the Environment must be contacted. The New Brunswick Department of Natural Resources must be immediately notified of any forest fires.

Assessment

Assessment of any herbicide operation involves two facets; a day-to-day analysis of the ongoing program and a longer term analysis of overall achievement of objectives. Assessment will understandably be extremely variable, depending on such things as the type, magnitude and complexity of the operation, the current state of refinement of the particular application and the amount of data collection required. Nevertheless, it should not be overlooked due to the potential for improving efficiency and acceptance of the operation, in addition to its influence on the future decision-making process regarding herbicide usage and its subsequent refinement.

Day-to-day assessment of operations will typically be carried out by supervisory and Department of the Environment personnel. It may involve recommendations for immediate improvement in coverage (e.g. improper swath width), chemical storage or transfer, relations with personnel or any other phase of the operation.

A variety of methodologies for post-treatment assessment are available. A decision as to the type and intensity of data collection should be made prior to treatment, and in conjunction with any pre-treatment data collection, particularly if the experimental design is to be statistically testable. Provision must also be given for "control" areas to facilitate the statistical interpretation of "before" and "after" data. A particular method of data collection which does not lend itself to elaborate statistical analysis may still serve to illustrate trends. Typical forms of data collection involve parameters (usually expressed in percent-

ages) of dominance and/or stocking of various species within sample plots (also of varying size) in the treatment area. Transects laid out perpendicular to the flight lines would identify any coverage problems and might provide a more accurate indication of response patterns. Determination of the amount of control, by species, achieved by a particular application is also common. Depending upon the scale and type of operation such information may be valuable in delineating cost efficient modifications, resulting in yearly improvements. Variations in the concentration and timing of applications may be contemplated.

A brief summary and cost analysis (Appendix 17) is carried out by the the New Brunswick Department of Natural Resources upon completion of each treatment. All areas are given peripheral visual inspection while a few post-treatment "spot checks", normally involving the above mentioned parameters, are carried out. It is recommended that a complete record be kept for each treated area on one form; this would include background information, objectives, prescriptions (concentrations, timing, etc.) and post-treatment evaluations (updated periodically).

In the development of any reporting system, consideration must be given to the inclusion of more than one post-treatment evaluation. Evaluation several years following treatment may prove to be valuable in the overall understanding of the program's effectiveness, in addition to determination of the necessity of a second treatment. The long-term, ultimate objective of any herbicide treatment involves wood fibre production, not specifically the immediate degree of weed suppression, and this must be addressed in any assessment.

APPENDIX 1

CERTIFICATION - PESTICIDE APPLICATORS

A - aerial application and/or aerial supervision

Class A Level 1 - entitles the holder to operate an aircraft applying pesticides, without spotter supervison or with spotter supervision.

Class A Level 2 - entitles the holder to operate an aircraft applying pesticides with direct spotter supervision.

Class A Level 3 - entitles the holder to act as a spotter and direct an operator (who holds Class A Level 2 certificate) of an aircraft applying pesticides.

Class A Level 4 - entitles the holder to supervise the mixing of pesticides and the loading of these pesticides into aircraft.

CERTIFICATION - PESTICIDE APPLICATORS

B - non-aerial application on agricultural crops, Christmas trees, plantations, tree nurseries and seed orchards.

Class B Level 1 - entitles the holder to operate hydraulic, airblast and other types of sprayers having high pressure potential; as well as operate equipment and perform functions as specified for Level 2 and Level 3 certificates.

Class B Level 2 - entitles the holder to operate; or, supervise non-certified personnel in the operation of, backpack (knapsack) sprayers, mistblowers or compressed air sprayers' as well as operate equipment and perform functions as specified for Level 3 certificate.

Class B Level 3 - entitles the holder to supervise the mixing of pesticides and the loading of these pesticides into equipment as referenced in Class B Level 1.

CERTIFICATION - PESTICIDE APPLICATORS

C - non-aerial application on forests, woodlands, industrial sites, airports, powerlines, pipelines, railways, roadsides or other rights-of-way.

Class C Level 1 - entitles the holder to operate hydraulic, airblast and other types of sprayers having high pressure potential; as well as operate equipment and perform functions as specified for Level 2 and Level 3 certificates.

Class C Level 2 - entitles the holder to operate; or, supervise non-certified personnel in the operation of, belly grinders, backpack (knapsack) sprayers, mistblowers or compressed air sprayers; as well as operate equipment and perform functions as specified for Level 3 certificate.

Class C Level 3 - entitles the holder to supervise the mixing of these pesticides into equipment as referenced in Class C Level 1.

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APPENDIX 2

APPLICATION FOR PESTICIDE APPLIER'S CERTIFICATE

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

DEMANDE DE CERTIFICAT D'UTILISATEUR DE PESTICIDES

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

Name of Applicant
Nom du requérant _____

Address
Adresse _____

_____ Postal Code
Code postal | | | | | |

Telephone Business
Téléphone Bureau _____ Home
Domicile _____

PLEASE NOTE

A fee of $10.00 payable to the Minister of Finance must accompany this application

I wish to be certified for the following class(es) of pesticide.

A. Aerial application and / or aerial supervision. ☐

B. Non-aerial application on agricultural crops, Christmas tree plantations, tree nurseries and seed orchards ☐

C. Non-aerial application on forests, woodlands, industrial sites, airports, power lines, pipelines, railways, roadsides or other rights-of-way. ☐

D. Non-aerial application on lawns, shrubs, trees, parks, school grounds and recreational areas. ☐

E. For structural pest control. ☐

F. For pest control in waste disposal sites. ☐

G. For indoor misting and fogging and fumigations. ☐

H. Application to water or waterways for control of aquatic pests and vegetation. ☐

I. Other (Please specify) ☐

_____

_____

List and dates of courses of instruction and training in the handling and use of pesticides

_____

_____

_____

_____

Briefly describe your practical experience in the use and handling of pesticides.

_____

_____

_____

_____

NOTE

La demande doit être accompagnée d'un droit de 10$ payable au ministre des Finances.

Je désire obtenir un certificat aux fins des catégories suivantes:

A. Application aérienne et / ou surveillance aérienne.

B. Application non-aérienne sur des récoltes agricoles, plantations d'arbres de Noël, pépinières d'arbres et vergers de semences.

C. Application non-aérienne sur les forêts, bosés, emplacements industriels et aéroports, au voisinage des lignes électriques, oléoducs et voies de chemins de fer et sur les bords des routes ou autres lieux d'exercice d'un droit de passage.

D. Application non-aérienne sur les pelouses, arbustes ou arbres ou dans les parcs, terrains scolaires et terrains réservés aux loisirs.

E. Pour la lutte antiparasitaire visant les bâtiments.

F. Pour la lutte antiparasitaire dans les dépotoirs.

G. Application sous forme de bruminations à l'intérieur des bâtiments et de pulvérisations thermiques et sous forme de fumigants.

H. Application à des étendues ou voies d'eau pour maîtriser les parasites et la végétation aquatiques.

I. Autres (veuillez spécifier).

Liste et dates de vos cours et de votre formation concernant la manutention et l'utilisation des pesticides.

Veuillez décrire brièvement votre expérience pratique de l'utilisation et de la manutention des pesticides.

Date _____ 19___ Signature _____

APPENDIX 3

APPLICATION FOR PESTICIDES OPERATOR'S LICENCE

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

DEMANDE D'UNE LICENCE D'EXPLOITANT DE PESTICIDES

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

Name of Applicant
Nom du requérant _____

Address
Adresse _____

_____ Postal Code / Code postal _____

Telephone Business / Téléphone Bureau _____ Home / Domicile _____

PLEASE NOTE:

A fee of $10.00 payable to the Minister of Finance must accompany this application.

Detail your experience with operating a pest control business. (Please include any formal training and courses studied).

NOTE:

La demande doit être accompagnée d'un droit de 10$ payable au ministre des Finances.

Décrivez votre expérience relative à l'exploitation d'une entreprise de contrôle des pesticides. (mentionnez les cours suivis et la formation reçue).

_____

_____

_____

_____

Certified Applicator / Utilisateur titulaire d'un certificat	Certificate No / N° de certificat

Use reverse of this form if additional listings are required

Utilisez le verso de cette formule pour ajouter à la liste, si nécessaire

Name of Insurance Company

Nom de la compagnie d'assurance

_____

Policy No.

Police n°

_____

Amount of public liability and property damage insurance (Attach a copy)

Montant d'assurance de la responsabilité civile et contre les dommages matériels (Annexer une copie)

$ _____

Date _____ 19____ Signature _____

21-1070 (4 83)

APPENDIX 4

APPLICATION FOR VENDOR'S LICENCE

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

DEMANDE D'UNE LICENCE DE VENDEUR

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

Name of Applicant
Nom du requérant _____

Address
Adresse _____

_____ Postal Code
Code postal |_|_|_|_|_|_|

Telephone Business
Téléphone Bureau _____ Home
Domicile _____

PLEASE NOTE:

A fee of $10.00 payable to the Minister of Finance must accompany this application.

NOTE:

La demande doit être accompagnée d'un droit de 10$ payable au ministre des Finances.

Outline your experience with handling of pesticides:

Résumez votre expérience de manutention de pesticides:

_____

_____

_____

_____

_____

_____

_____

_____

List any courses or formal training you have taken:

Mentionnez les cours suivis et la formation reçue:

_____

_____

_____

_____

_____

Class(es) of pesticide(s) to be sold:

catégorie(s) de pesticide(s) devant être mis en vente:

☐ Commercial
Commerciale

☐ Restricted
A usage restreint

Date _____ 19____ Signature _____

21 1065 (4 83)

APPENDIX 5

APPLICATION FOR RENEWAL OF LICENCE / CERTIFICATE

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

DEMANDE DE RENOUVELLEMENT D'UNE LICENCE OU D'UN CERTIFICAT

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

Name of Applicant
Nom du requérant _____

Address
Adresse _____

_____ Postal Code / Code postal _____

Telephone Business / Téléphone Bureau _____ Home / Domicile _____

I wish to renew:

1. Vendor's Licence No. ☐ V _____
2. Pesticide Operator's Licence No. ☐ O _____
3. Pesticide Applier's Certificate No. ☐ A _____

Je désire renouveler:

1. la licence de vendeur n° ☐
2. la licence d'exploitant de pesticides n° ☐
3. le certificat d'utilisateur de pesticides n° ☐

There (have, have not) been changes in my business operation or pesticide storage facilities in the past year. (Provide details if required)

Il (y a eu des, n'y a pas eu de) changements dans l'exploitation de mon commerce ou dans les installations d'entreposage des pesticides au cours de l'année écoulée. (Donner les détails s'il y a lieu)

_____

_____

_____

_____

Describe any additional courses of instruction or training completed in the past year

Cours ou formation supplementaires au cours de l'année écoulée:

_____

_____

_____

_____

PLEASE NOTE:

A renewal fee of $10.00 for each licence or certificate, payable to the Minister of Finance must accompany this application.

NOTE:

La demande doit être accompagnée d'un droit de 10$ pour chaque licence ou certificat, payable au ministre des Finances.

Date _____ 19____ Signature _____

21-1067 (4-83)

APPENDIX 6

ANNUAL RECORD OF PESTICIDES USED (AERIAL)

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

REGISTRE ANNUEL DES PESTICIDES UTILISÉS (PAR VOIE AÉRIENNE)

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

January 1. to December 31.
1er janvier au 31 décembre 19 _____

This record to be forwarded to the Director of Pesticides Control on or before December 31.

Le présent registre doit être envoyé au directeur du contrôle des pesticides au plus tard le 31 décembre.

Licensee
Titulaire de licence _____ **Licensee No.**
N° de licence _____

Address
Adresse _____

_____ **Postal Code**
Code postal _____

Telephone **Business**
Téléphone **Bureau** _____ **Home**
Domicile _____

Pesticide	P.C.P. Registration No. N° d'enregistrement du produit	Application Rate Taux d'application	No. of Hectares Treated N° d'hectares traités	Amount Used Quantité utilisée (kg. litres)

ANNUAL RECORD OF PESTICIDES USED (NON AERIAL)

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

REGISTRE ANNUEL DES PESTICIDES UTILISÉS (PAR VOIE NON-AÉRIENNE)

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

January 1. to December 31.
1er janvier au 31 décembre 19 ____

This record to be forwarded to the Director of Pesticides Control on or before December 31.

Le présent registre doit être envoyé au directeur du contrôle des pesticides au plus tard le 31 décembre.

Licensee
Titulaire de licence _____ **Licensee No.** **N° de licence** _____

Address
Adresse _____

_____ **Postal Code** **Code postal** _____

Telephone **Business**
Téléphone **Bureau** _____ **Home** **Domicile** _____

Pesticide	P.C.P. Registration No. N° d'enregistrement du produit	Application Rate Taux d'application	No. of Hectares Treated N° d'hectares traités	Amount Used Quantité utilisée (kg, litres)

APPENDIX 7

VENDOR'S SALES RECORD

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

COMMERCIAL, AGRICULTURE, INDUSTRIAL PESTICIDES

REGISTRE DE VENTES DU VENDEUR

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

PESTICIDES COMMERCIAUX, AGRICOLES, INDUSTRIELS

19 _____

Name of Applicant
Nom du requérant _____

Address
Adresse _____

_____ **Postal Code** **Code postal** _____

Telephone **Business**
Téléphone **Bureau** _____ **Home** **Domicile** _____

This record to be completed and forwarded to the Director of Pesticides Control on or before December 31 of current year.

Le présent registre doit être rempli et envoyé au directeur du contrôle des pesticides au plus tard le 31 décembre de l'année en cours.

Pesticide	P.C.P. Registration No. (must be included) N° d'enregistrement du produit (doit être indiqué)	Amount Sold Quantité vendue (kg, litres)

Use reverse of this form for additional listings if needed

Utilisez le verso de cette formule pour ajouter à la liste, si nécessaire.

Date _____ **19**____ **Signature** _____

21-1088 (4 83)

APPENDIX 8

RESTRICTED PESTICIDES PURCHASE REQUISITION

DEPARTMENT OF THE ENVIRONMENT — GENERAL REGULATIONS — PESTICIDES CONTROL ACT

REGISTRE D'ACHATS DE PESTICIDES À USAGE RESTREINT

MINISTÈRE DE L'ENVIRONNEMENT — RÈGLEMENT GÉNÉRAL — LOI SUR LE CONTRÔLE DES PESTICIDES

Vendor
Vendeur _____

Address
Adresse _____

Licence No.
N° de licence _____

Postal Code
Code postal _____

This record to be forwarded to the Director of Pesticides Control on or before December 31.

Le présent registre doit être envoyé au directeur du contrôle des pesticides au plus tard le 31 décembre.

Date	Customer's Name and Address Nom et adresse du client	Chemical Name Désignation chimique	Quantity Quantité (kg, litre)	PCP No. N° d'enreg. du produit	Intended Use Utilisation prévue			Pest Controlled Parasite supprimé	Customer's Signature Signature du client	Vendor's Signature Signature du vendeur
					Home Domest.	Farm Ferme	Other Autre			

21-1069 (4/83)

APPENDIX 9

NOTIFICATION

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

AVIS

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

I,
Je soussigné, _____ of
de _____

have notified (name of local fire department)

ai avisé: (nom du service local d'incendie)

_____

and (name of nearest regional office of the Department of Health)

et (nom du bureau régional le plus rapproché du ministère de la Santé)

_____

that I am storing the following pesticides:

que j'entrepose les pesticides suivants:

Pesticide	Pesticide

Use reverse side of this form for additional listings, if required

Utilisez le verso de cette formule pour ajouter à la liste, si nécessaire

Please forward the original to the local fire department and copies to:

Director of Pesticides Control
Department of The Environment
P.O. Box 6000
Fredericton, N.B.
E3B 5H1

AND

Regional Office
Department of Health

Veuillez adresser l'original au service local d'incendie et une copie au:

Directeur du contrôle des pesticides
Ministère de l'Environnement
C.P. 6000
Fredericton, N.-B.
E3B 5H1

ET au

Bureau régional
Ministère de la Santé

Date _____ 19____ Signature _____

21-1086 (4-83)

APPENDIX 10

APPLICATION FOR A PERMIT (AERIAL)

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

DEMANDE DE PERMIS (PAR VOIE AÉRIENNE)

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

Name of Applicant
Nom du requérant _____

Address
Adresse _____

_____ **Postal Code** **Code postal** _____

Telephone **Business** **Téléphone** **Bureau** _____ **Home** **Domicile** _____

Name of Licensed Operator
Nom de l'exploitant titulaire d'une licence _____

Name of Certified Applicator
Nom de l'utilisateur titulaire d'un certificat _____

If more than one applier is involved, a supplementary list must accompany this application.

Vous devez annexer une liste supplémentaire si la demande concerne plus d'un utilisateur.

Description of application equipment:

_____

_____

Description de l'équipement d'application:

_____

_____

Nozzle type and pressure (where applicable):

_____

Genre de jet et pression (s'il y a lieu):

_____

Proposed dates of pesticide application:

from **du** _____ **to** **au** _____

Dates projetées d'application du pesticide:

Location of treatment area and method of container disposal

_____

Emplacement du secteur de traitement et méthode d'élimination des récipients

_____

Pesticide	P.C.P. Registration No. N° d'enregistrement du produit	Application Rate Taux d'application	Hectares to be Treated Nombre d'hectares à traiter

Use reverse of this form for additional listings if required

Utilisez le verso de cette formule pour ajouter à la liste, si nécessaire

PLEASE NOTE:

If the pesticide application involves the application of a non-registered chemical then the appropriate Federal research permit must be forwarded to the Director of Pesticides Control.

Appropriate maps indicating the location of treatment areas must accompany this application. Maps should be of a scale that clearly denotes the treatment and surrounding areas.

Completed applications to be forwarded to:

Minister of the Environment
P.O. Box 6000, Fredericton, N.B.
E3B 5H1

All inquiries concerning permits and requests for applications should be sent to:

Director of Pesticides Control
Department of the Environment
P.O. Box 6000, Fredericton, N.B.
E3B 5H1

NOTE:

Si l'application du pesticide entraîne celle d'un produit chimique non enregistré, le permis de recherche fédéral pertinent doit être adressé au Directeur du contrôle des pesticides.

Il faut joindre à la demande les cartes pertinentes indiquant l'emplacement des secteurs de traitement. Les cartes doivent être à une échelle indiquant clairement les secteurs de traitement et les secteurs environnants.

La demande dûment remplie doit être transmise à:

M. le Ministre de l'environnement
C.P. 6000, Fredericton, N.-B.
E3B 5H1

Pour tous renseignements concernant les permis et les demandes d'applications, veuillez vous adresser à:

M. le directeur du contrôle des pesticides
Ministère de l'environnement
C.P. 6000, Fredericton, N.-B.
E3B 5H1

Date _____ **19**____ **Signature** _____

APPENDIX 11

APPLICATION FOR A PERMIT (GROUND)

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

DEMANDE DE PERMIS (AU SOL)

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

Name of Applicant
Nom du requerant _____

Address
Adresse _____

_____ Postal Code
Code postal | | | | | |

Telephone Business
Téléphone Bureau _____ Home
Domicile _____

Name of Licensed Operator
Nom de l'exploitant titulaire d'une licence _____

Name of Certified Applicator
Nom de l'utilisateur titulaire d'un certificat _____

If more than one applier is involved, a supplementary list must accompany this application.

Vous devez annexer une liste supplémentaire si la demande concerne plus d'un utilisateur.

Description of application equipment:

Description de l'équipement d'application:

_____

_____

Nozzle type and pressure (where applicable):

Genre de jet et pression (s'il y a lieu):

_____

Proposed dates of pesticide application:

Dates projetées d'application du pesticide:

from / du _____ to / au _____

Location of treatment area and method of container disposal

Emplacement du secteur de traitement et méthode d'élimination des récipients

_____

Pesticide	P.C.P. Registration No. / N° d'enregistrement du produit	Application Rate / Taux d'application	Area to be Treated / Secteur à traiter

Use reverse of this form for additional listings if required

Utilisez le verso de cette formule pour ajouter à la liste, si nécessaire

PLEASE NOTE:

If the pesticide application involves the application of a non-registered chemical then the appropriate Federal research permit must be forwarded to the Director of Pesticides Control.

Where applicable, appropriate maps indicating the location of treatment areas must accompany this application.

Completed applications to be forwarded to:

Minister of the Environment
P.O. Box 6000, Fredericton, N.B.
E3B 5H1

All inquiries concerning permits and requests for applications should be sent to:

Director of Pesticides Control
Department of the Environment
P.O. Box 6000, Fredericton, N.B.
E3B 5H1

NOTE:

Si l'application du pesticide entraine celle d'un produit chimique non enregistre, le permis de recherche fédéral pertinent doit être adressé au Directeur du contrôle des pesticides.

Il faut, le cas échéant joindre à la demande les cartes pertinentes indiquant l'emplacement des secteurs de traitement.

La demande dûment remplie doit être transmise à:

M. le Ministre de l'environnement
C.P. 6000, Fredericton, N.-B.
E3B 5H1

Pour tous renseignements concernant les permis et les demandes d'applications, veuillez vous adresser à:

M. le directeur du contrôle des pesticides
Ministère de l'environnement
C.P. 6000, Fredericton, N.-B.
E3B 5H1

Date _____ 19____ Signature _____

APPENDIX 12

ORDER

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

ORDONNANCE

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

To:
Destinaire _____

(Name / Nom)

of
de _____

(Address / Adresse)

_____

You are hereby notified that the use, storage, transportation, application or disposal of (Insert name of pesticide or pesticide container)

Vous êtes avisé par la présente que l'usage, l'entreposage, le transport, l'application ou l'élimination de (Nom du pesticide ou du récipient à pesticides)

_____

or the use of any method in connection therewith is considered to be:

ou l'usage d'une méthode y relative, est considéré(e):

a. contrary to the Pesticides Control Act or any regulation made thereunder for the following reasons:

a. contraire à la Loi sur le contrôle des pesticides ou à ses règlements d'application, pour les motifs suivants:

_____

_____

b. dangerous to the health of a person or animal or harmful to soil, crops or plant life (specify reasons)

b. dangereux (se) pour la santé d'une personne ou d'un animal ou nuisible au sol, aux recoltes ou aux végétaux pour les motifs suivants:

_____

_____

c. contrary to any condition or restriction attached to a permit issued under section 12 of the Pesticides Control Act (specify reasons):

c. contraire à une condition ou à une restriction du permis délivré en application de l'article 12 de la Loi sur le contrôle des pesticides pour les motifs suivants:

_____

_____

You are hereby ordered to stop immediately the above-mentioned use, storage, transportation, application or disposal of the pesticide (or pesticide container), or the use of any method in connection therewith, (Insert: permanently or Specify: the period of time)

Il vous est enjoint par la présente de cesser sans délai l'usage, l'entreposage, le transport, l'application ou l'élimination, ci-haut mentionné du pesticide (ou du récipient à pesticides), ou l'usage d'une méthode y relative, (en permanence ou en spécifier la durée)

_____

Issued the day of
Fait le _____ **19**___ **at**
à _____ _____
City / Ville Province

Inspector
Inspecteur _____ **Address**
Adresse _____

21-1077 (4 83)

APPENDIX 13

NOTICE OF APPEAL

DEPARTMENT OF THE ENVIRONMENT
GENERAL REGULATION
PESTICIDES CONTROL ACT

AVIS D'APPEL

MINISTÈRE DE L'ENVIRONNEMENT
RÈGLEMENT GÉNÉRAL
LOI SUR LE CONTRÔLE DES PESTICIDES

I,
Je soussigné, _____ of
de _____

_____

hereby serve notice of appeal upon the Pesticides Advisory Board as provided for by section 29 of the Pesticides Control Act, chapter P-8 of the Revised Statutes of New Brunswick, 1973, against the attached order (attach a copy of the order).

signifie un avis d'appel à la Commission consultative des pesticides en application de l'article 29 de la Loi sur le contrôle des pesticides, chapitre P-8 des Lois révisées du Nouveau-Brunswick de 1973, à l'encontre de l'ordonnance ci-jointe (joindre une copie de l'ordonnance).

I consider myself aggrieved by the above order and request a hearing before the Pesticides Advisory Board as provided for by subsection 29(2) of the Pesticides Control Act.

J'estime que l'ordonnance susvisée me cause préjudice et je sollicite une audience devant la Commission consultative des pesticides en application du paragraphe 29(2) de la Loi sur le contrôle des pesticides.

The grounds for my appeal are as attached or as follows:

Mes motifs d'appel sont indiqués ci-après ou sur le feuillet ci-joint:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Dated this
Fait le _____ day of _____ 19___ at
à _____ _____
City / Ville Province

Signature of Applicant
Signature du requérant _____ Telephone
Téléphone _____

Address
Adresse _____

21-10/8 (4 83)

APPENDIX 14

DEPARTMENT OF NATURAL RESOURCES

AERIAL SPRAYING
LOAD RECORD

REGION: _____ WIND SPEED: _____

LOCATION: _____ TEMPERATURE: START: _____

DATE: _____ FINISH: _____

Load No.	Delivered by Aircraft	Pilot	Herbicide	Rate	Time Out	Time In	Total Time	No. Gal.	Area No.

APPENDIX 15

TOXIC SUBSTANCES SECTION

PESTICIDE CONTINGENCY PLAN

Environmental Services Branch

Department of Environment

Province of New Brunswick

1984

PESTICIDE CONTINGENCY PLAN

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I. DEFINITIONS

A. INCIDENT

Report of a perceived violation of a permit or of an application to people or property in the vicinity of a spray block (may be made through the toll free Zenith 08012 phone number).

B. VIOLATION

Infraction of the pesticides control act, the regulations or a permit condition which may lead to legal action or the revoking of a licence, permit, or certification.

C. MISHAP

Accidental application of a pesticide to the environment as a result of equipment failure or spillage.

D. REQUEST

Requests from the public for analysis of a drinking water supply made as a result of general concern rather than an incident, violation or mishap.

2. RESPONSIBILITY CHART

EVENT	APPROVAL	SAMPLING	ANALYSIS	RESULTS REPORTED
1. Incident				
A. Proximity to habitation	Hea-Env	Hea-Env	Hea-Env	Health
B. People Sprayed	Hea-Env	Hea-Env	Hea-Env	Health
C. Environmental	Env	Env	Env	
2. Violation				
A. Licence	Env	Env	Env	
B. Permit	Env	Env	Env	
3. Mishaps				
A. To Drinking Water	Health	Env	Env	Health
B. Near Habitation	Health	Env	Env	Health
C. Environmental	Env	Env	Env	Env
4. Requests				
A. Self Inflicted to Drinking Water	Health	Env	Env	Health
B. Self Inflicted to Land	Health	Env	Env	Health
C. Application Related Health	Health	Env-Hea	Env-Hea	

RESPONSE

In the event a pesticide incident or mishap requiring a response occurs:

Upon notification of the incident or mishap, Toxic Substances Section, Environment New Brunswick will:

1. Contact Department of Health, Ron Hicks, 453-2397

   - Determine appropriate action warranted by situation- see sample instructions.

2. Contact Regional Environment New Brunswick Staff (see list).

In the event Toxic Substances Section Staff are unable to properly respond to a situation involving pesticides, Regional Environment New Brunswick Staff will be contacted and asked to initiate response and sampling (as per sampling instructions) if required.

If Regional Environment New Brunswick staff are notified of a pesticide incident or mishap through Zenith 49000 (Coast Guard) Toxic Substances section personnel should be contacted. Instructions to initiate the response can then be given.

Regional Staff should contact Toxic Substances Section personnel after investigation and evaluation (sampling if required) are completed.

Department of Natural Resources Regional Staff (see list) may be asked to aid investigating Environment New Brunswick personnel in accessing unfamiliar areas.

Department of Health Staff will be notified of response carried out by Environment New Brunswick personnel and interpret analytical results with regards to health matters.

ENVIRONMENT NEW BRUNSWICK REGIONAL STAFF

BATHURST

Denis Daigle
Environmental Inspector
DEPARTMENT OF THE ENVIRONMENT
P. O. Box 5001
Bathurst, N. B.
E2A 3Z9

TEL: 546-2360

CHATHAM

Paul Cormier
Environmental Inspector
DEPARTMENT OF THE ENVIRONMENT
Provincial Building
337 Water Street
Chatham, N. B.
E1N 1B2

TEL: 773-6032

FREDERICTON

David J. Williams
Chief Inspector

John Benson
Environmental Inspector

Fred McLellan
Environmental Inspector

DEPARTMENT OF THE ENVIRONMENT
364 Argyle Street
Pollution Control Branch
P. O. Box 6000
Fredericton, N. B.
E3B 5H1

GRAND FALLS

Andre Chenard
Environmental Inspector
DEPARTMENT OF THE ENVIRONMENT
P. O. Box 5001
Grand Falls, N. B.
E0J 1M0

TEL: 473-5268

MONCTON

Joe Richard
District Environmental Inspector
DEPARTMENT OF THE ENVIRONMENT
P. O. Box 5001
Moncton, N. B.
E1C 8R3

TEL: 858-2588

SAINT JOHN

David B. Roy
Environmental Inspector

Sephen Drost
Environmental Inspector

DEPARTMENT OF THE ENVIRONMENT
12th Floor, Suite 1232,
City Hall Building
15 North Market Square
Saint John, N. B.
E2L 1E8

TEL: 658-2558

DEPARTMENT OF NATURAL RESOURCES

DNR - REGIONAL STAFF - WILDLIFE BIOLOGISTS

REGION 1 - P. O. Box 170
Bathurst, N. B.
E2A 3Z

PHONE: 546-6611
(Vanier Boulevard Extension) 546-6611
GILLES GODIN

REGION 2 - 80 Pleasant Street
Newcastle, N. B.

E1V 1X7

PHONE: 622-2636
ROBERT CURRIE

REGION 3 - P. O. Box 150
Hampton, N. B.
E0G 1Z0

PHONE: 832-5532
(On Rte. 121/333 Main St.)
THOMAS PETTIGREW

REGION 4 - R.R.#6, Fredericton, N. B.
E3B 4X7

PHONE: 454-9769
PETER CRONIN

REGION 5 - P. O. Box 398, Edmundston, N. B.
E3V 3L1

PHONE: 735-4751
NORM PRENTICE

EMERGENCY PROCEDURES - PESTICIDE SPILLS

A. **For all Spills:**

1. Where the pesticide has spilled onto the skin, immediately wash the area thoroughly with soap and water.
2. Remove all contaminated clothing and wash separately.
3. If anyone in the area feels unwell, seek medical advice immediately. Attain label if possible.
4. Put on the recommended safety equipment and clean up spill as quickly and safely as possible.
5. Decontaminate the affected area.
6. Complete pesticide Incident Report form (by applicator) and Pesticide Damage Investigation Report (by inspector) for pesticide spill and forward to the Department of the Environment.

B. **For Major Spills: (Ground spills greater than 200 l; all jettisoned loads or spills from aircraft)**

1. Follow items in Step A, where feasible.
2. Contact ENVIRONMENTAL EMERGENCY NUMBER (Zenith 49,000).
3. Contact Ron Hicks, Department of Health (453-2397).
4. Contact Toxic Substances Section (Zenith 08012)
5. Notify people living or working in the area that a spill of pesticide has occurred.

INVESTIGATION OF PESTICIDE SPILLS

1. Put on the recommended safety equipment before entering an area where there has been a recent spill of pesticide.

2. Collect the pesticide Incident Report form from the applicator.

3. Complete a Pesticide Damage Investigation Report form.

4. Make sure area has been decontaminated.

5. Take the necessary steps to prevent to prevent the pesticide from further contaminating the environment. This may require the removal of soil or water to an approved site.

6. Collect samples if requested.

7. Ensure you know the name of the pesticide involved and P.C.P.#, or secure a label for more specific detail.

EMERGENCY PROCEDURES - JETTISONED LOADS

Applicator

1. Follow Sections A and B of Emergency Procedures - Pesticide Spills

Investigator

1. Collect Pesticide Incident Report form.
2. Complete Pesticide Damage Investigation Report form.
3. Where feasible, take the necessary action to prevent further contamination of the environment.
4. Collect samples, if requested.

Safety Equipment

Protective clothing should be worn whenever anyone enters an area where pesticides have been spilled:

- hooded rubber rainsuits
- rubber gloves
- respirators with replaceable approved cartridges
- splash goggles
- steel-toed rubber boots

After being worn, this protective gear should be rinsed off with a detergent and water solution.

Decontamination

Call Toxic Substances Section (Environment New Brunswick) Zenith 08012 (MAY-SEPT) or 453-2669.

For Information on Decontamination

In the event Environment New Brunswick staff cannot be contacted immediately, call CANUTEC at 1-613-996-6666 for information on decontamination.

Dike or cover spills to prevent dispersal.

Add recommended neutralizing agent to initiate degradation.

Absorb with sawdust, charcoal, etc.

Sweep or shovel up material into labelled containers.

Bury all material in approved landfill. (Disposal sites to be designated by the Department of the Environment.)

PESTICIDE INCIDENT REPORT

DATE: _____

TIME: _____

PESTICIDE (formulation): _____

_____

QUANTITY SPILLED: _____

LOCATION (be specific): _____

_____

_____

_____

REASON FOR SPILL: ___ mechanical failure ___ leaking nozzles

___ carelessness ___ emergency

DECONTAMINATION PROCEDURES: _____

_____

_____

_____

EMERGENCY PHONE NUMBERS TO CALL:

1. Zenith 49000
2. Ron Hicks 453-2397
3. Ken Browne 453-2669 (or Zenith 08012 May-Oct)

FIRST AID TREATMENT (if necessary) _____

_____

_____

BLOOD SAMPLES: ___ YES ___ NO (or organophosphate poisoning)

PESTICIDE DAMAGE INVESTIGATION REPORT

NAME OF APPLICATOR: _____

ADDRESS: _____ TEL: _____

NAME OF LANDOWNER: _____

ADDRESS: _____ TEL: _____

NAME OF INSPECTOR: _____ TEL: _____

ADDRESS: _____

SUSPECTED PESTICIDE: _____ DATE SPILLED: _____

Fungicide: _____ Herbicide: _____

Insecticide: _____ Unknown: _____

LOCATION: _____ PARISH: _____

COUNTY: _____

DETAILS OF AREA AFFECTED: _____

SIZE OF SPILL: _____

DISTANCE FROM: Surface water: _____
Settled area: _____

SOIL TEXTURE: Light _____ Medium _____ Heavy _____

DRAINAGE: _____ GOOD: ____ FAIR: ____ POOR: ____

WEATHER: wet _____ dry _____ windy _____ calm _____

SKETCH EFFECTED AND SURROUNDING AREA. RELATED TO TOPOGRAPHY, DRAINAGE, ROADS, ETC.

WATER _____ SOIL _____ ENVIRONMENT _____

OTHER INFORMATION:

EMERGENCY TELEPHONE NUMBERS

Emergency Number, Environment Canada - Halifax

Canadian Coast Guard Traffic Centre ..... ZENITH 49000

Poison Control Centres

BATHURST	Chaleur General Hospital	
	Poison Control	546-4666
	Hospital	548-8961
CAMPBELLTON	Hotel Dieu Hospital	
	Poison Control	753-5212
	Hospital	753-3301
EDMUNDSTON	Hotel Dieu d' Edmundston	
	Poison Control	735-7384
	Hospital	735-3361
FREDERICTON	Dr. G. Everett Chalmers Hospital	
	Poison Control	452-5400
	Hospital	452-5400
SAINT JOHN	Saint John Regional - Central Div.	
	Poison Control	648-7111
	Hospital	648-6000
MONCTON	Moncton City Hospital	
	Poison Control.....	388-3005
	Hospital	855-1600

Other Hospitals

DALHOUSIE	St. Joseph Hospital	684-3391
GRAND FALLS	Grand Falls General Hospital ...	473-1550
MINTO	Minto Hospital Ltd.	327-3353
NEWCASTLE	Miramichi Hospital	622-1340
OROMOCTO	Oromocto Public Hospital	357-8465
WOODSTOCK	Carleton Memorial Hospital	328-3391
ST. STEPHEN	Charlotte County Hospital	455-1140
ST. QUENTIN	Hotel Dieu Hospital	235-2300
HARVEY	Harvey Community Hospital	366-2812
BATH	Bath Community Hospital	378-5231

Health Services Centre

CHIPMAN	Chipman Health Services Centre .	339-6661
DOAKTOWN	Doaktown Health Services Centre	365-4637
PLASTER ROCK	Tobique Valley Medical Clinic..	356-2687
STE ANNE DE KENT	Hospital Stella-Maris de Kent ..	743-2407
CARAQUET	Hospital de l'enfant Jesus ...	727-3435
TRACADIE	Hotel Dieu Saint-Joseph	395-3361

NOTE: List is incomplete, any hospitals or health service centres missing will be added as they become known.

Ambulance Service - Incomplete

BATH	Northern Carleton	278-5231
BLACKVILLE	St. John Ambulance	843-2888
CAMPBELLTON	Campbellton Nursing Home Inc....	753-6222
CHIPMAN	Chipman Ambulance Service	339-6611
DALHOUSIE	St. John Ambulance	684-4711
EDMUNDSTON	Edmundston Ambulance Ltd.	735-8437
FREDERICTON	Dr. G. Everett Chalmers Hospital	452-5400
GRAND FALLS	St. John Ambulance	473-4565
	O'Regan Ambulance	473-2338
HARTLAND	Hartland Community Ambulance ...	375-4493
MINTO	Minto Ambulance	327-3838
MONCTON	Moncton City Hospital	855-1600
	St. John Ambulance	382-6266
	Riverview Municipal Ambulance...	386-8821
NEWCASTLE	Miramichi Ambulance Service	622-1340
PERTH-ANDOVER	Perth-Andover Southern Victoria Ambulance Service	273-2201
SAINT JOHN	St. John Ambulance	652-3549
	Saint John General Hospital	658-2112
ST. ANNE DE MADAWASKA	St. Anne de Madawaska Ambulance	445-2449
ST. LEONARD	St. Leonard Municipal Ambulance Service	423-6382
ST. QUENTIN	St. Quentin Municipal ..... Ambulance Service	235-2300
ST. STEPHEN	Kenneth Holmes Ambulance Service	466-4164

• NOTE: Incomplete list: Any ambulance service not on list will be added as they become known.

Emergency Response Telephone Numbers

DOW CHEMICAL LTD.....	519-339-3711	24 HOURS/DAY
MONSANTO CHEMICAL LTD.	314-694-4000	24 HOURS/DAY
DUPONT CHEMICAL LTD.	302-774-1000	24 HOURS/DAY
CHEMAGRO LTD.	416-661-2262 816-242-2000	24 HOURS/DAY
SUMITOMA CANADA LTD.	613-379-5531	24 HOURS/DAY
CYANAMID LTD.	416-356-8310	24 HOURS/DAY
CHIPMAN INC.	416-643-4123 416-528-6771	AFTER HOURS
CANADIAN CHEMICAL PRODUCERS ASSOCIATION - TRANSPORTATION EMERGENCY ASSISTANCE PLAN	613-348-3616	24 HOURS/DAY
EASTERN CANADA REPRESENTATIVES:		
- ALLIED CHEMICAL	514-373-8330	
- GULF OIL LTD.	819-537-1123	
ENVIRONMENT CANADA EMERGENCY NUMBER		
CANADIAN COAST GUARD TRAFFIC CENTRE	ZENITH 49000	
CANUTEC	1-613-996-6666	24 HOUR EMERGENCY NO. INFO. ON DECONTAMINATION

Aircraft Charter

Fredericton Flying Club Inc.
FREDERICTON 357-8457

Trans-Maritime Helicopter
FREDERICTON 357-3336

Dionne Flying Service
GRAND FALLS 473-2337

Frontair
EDMUNDSTON 735-4857

Moncton Flying Club
MONCTON 382-1773

Air New-Bec
BATHURST 546-4454

Border Air Services Ltd. 466-1002

GENERAL PESTICIDE SAMPLING METHODS

IMPORTANT: Know what pesticide is to be sampled. Notify the laboratory and/or cnemist that is to carry out the analysis as there may be specific sampling instructions pertaining to the method of analysis (e.g., amount and type of preservative).

LABELLING:

All Samples: assign field number (on bottle)

- RECORD: field number
  date
  where sample taken
  time

- FOR WATER SAMPLES:

  a) Surface Water - depth at which sample obtained ex. surface, 10 cm

  b) Wells - Depth of well if available

- FOR SOIL SAMPLES - DEPTH

WATER SAMPLES:

Use a 1 litre dark brown glass bottle that has been prepared for the pesticide to be sampled. For instance, the cleaning procedure for bottles used for herbicides is different than for insecticides. Rinse the bottle with the sample twice. In the case of surface water samples, face the neck of the bottle upstream and/or away from sampler or boat. It is important to rinse hands or gloves prior to sampling to avoid contamination. Caution should be taken to botain the cleanest (visible) sample possible as particulate matter may cuase interference in sample analysis. To facilitate this, care should be taken when sampling shallow waterways so as not to distrub the bottom with the sample bottle

or movement of the sampler. In the case of private well sampling, the well should be flushed (ex. in a house before obtaining sample.[1]

Fill bottle to shoulder (approx. 3 - 4 cm from the top), add appropriate preservative, and cap tightly using foil, rinsed with preservative, under the cup. Mix well. Care should be taken in labelling bottles as condensation on bottles can cause labels to fall off and samples become mixed up. Label (masking tape works well) should be wrapped around sample bottle several times to prevent this.

Label and sample number should be put on sampling bottle prior to taking sample.

* Ship labelled sample to lab as soon as possible. Never transport environmental samples with tank mix or any sample that may cause contamination.

---

[1]When sampling well water for pesticides the collection of a water sample for routine water quality analysis (ex. pH,hardness, nitrate-nitrite, etc.) can provide additional useful information.

EQUIPMENT:

Water Samples:

1 litre brown glass bottle - rinsed for appropriate pesticide

tape and waterproof markers for labelling

appropriate preservative

cooler and ice supply to keep sample cool enroute to laboratory (if required)

Soil Samples:

Use a mason jar that has been cleaned for pesticides or herbicides as the case may be. Fill jar to capacity with a metal scoop or spoon, that can be disposed of or well rinsed with distilled water for further sampling. Drain off all excess water and cover with clean aluminum foil. (If soil is very wet the jar should not be filled to capacity as the jar may break if freezing of the sample is required.) Do not fill with vegetation or stones. Cap and cool or freeze as required. Ship carefully labelled sample to lab as soon as possible.

EQUIPMENT:

Soil Samples:

mason jar - rinsed for pesticide or herbicide

tape and waterproof marker for labelling

cooler and ice supply to cool or freeze sample while enroute to laboratory

sampling scoop/spoon - metal

distilled water to rinse scoop/spoon with if it is to be reused.

Environmental Samples

Using clean aluminum foil, wrap the sample (vegetation, small animal, large animal tissue) and place in a labelled plastic bag. Keep sample cool and freeze as soon as possible. Arrange to have the frozen sample delivered to the laboratory. Avoid possible contamination of sample while sampling and transporting.

Equipment:

Environmental Samples
roll aluminum foil
plastic bag
waterproof marker for labelling
cooler and ice supply to cool or freeze sample
while enroute to laboratory

Air Samples

Using a calibrated suction pump placed in an area free of other disturbances (e.g. car exhaust) equipped with the required column, (see chemist performing analysis), run the pump for a known period of time. (e.g. 1 hour), remove, wrap the column in clean metal foil, tape, cool, and transport to laboratory as soon as possible.

Equipment:

Air Sample
Suction Pump - calibrated
Batteries
Roll Aluminum Foil
Column - containing proper resin
Waterproof marker for labelling
Tape

APPENDIX 16

DISPOSAL SITES FOR PESTICIDE CONTAINERS

The following disposal sites*, operated by the Department of Transportation may be used for disposing triple-rinsed and punctured pesticide containers. Further information may be obtained by contacting the neareat office of the New Brunswick Department of the Environment.

ALBERT
605 ELGIN
606 TURTLE CREEK

CARLETON
1307 SUMMERFIELD
1309 LAKEVILLE
1310 WATERVILLE
1311 DEBEC-KENT HILL ROAD

CHARLOTTE
707 BASSWOOD RIDGE
710 LAWRENCE STATION
711 ROIX ROAD
712 BONNY ROAD-MEADOW ROAD
713 NEW RIVER BEACH
714 DEER ISLAND
715 CAMPOBELLO ISLAND
716 WHITEHEAD ISLAND

GLOUCESTER
210 ST. SAUVEUR
211 ROUGH WATERS RD.
212 ALLARDVILLE
213 CLIFTON-CANOBIE
216 ST. SIMON
220 ST. CECILE
221 MISCOU ISLAND

KENT
408 ST. PAUL
417 ACADIAVILLE

KINGS
905 HAVELOCK (CANAAN RD.)
906 CORNHILL
907 FIVE POINTS
909 BELLEISLE CREEK
911 KINGSTON
912 BROWN'S FLAT

MADAWASKA
1512 SIEGAS
1513 CONNORS

NORTHUMBERLAND
310 PARKER ROAD
312 ST. MARGARETS-RTE. 440
313 COUNTY LINE-RTE. 117
315 BELLEFOND ROAD
317 BRANTVILLE

QUEENS
1005 KELLY RD.-RTE. 112
1008 WICKHAM
1010 WELSFORD

RESTIGOUCHE
109 ROBINSONVILLE
110 ST. JEAN BAPTISTE
111 ST. MARTINS

SAINT JOHN
804 GROVE HILL

SUNBURY
1103 LAKEVILLE CORNER
1104 GEARY-RTE. 660
1107 HAMM ROAD

VICTORIA
1406 TILLEY
1408 ARTHURETTE-OFF RTE. 109
1409 BON ACCORD
1411 TWO BROOKS

WESTMORLAND
509 HALL'S HILL
510 LA HETRIERE
511 BERRY MILLS

YORK
1209 DURHAM RTE. 628
1210 NAPADOGAN
1213 ZEALAND
1217 BROCKWAY-RTE. 3
1219 MAGUNDY-LAKE GEORGE
1220 ASTLE
1221 FOSTERVILLE

*THESE LOCATIONS ARE SUBJECT TO CHANGE

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APPENDIX 17

LICENSEE:

HERBICIDE PROGRAM

Area #	Location	Map #	Target Size (ha)	Rate of Herbicide	Area Description	Dates Sprayed	Volume Delivered (L)	Applicators Flight Time (hr:min)

HERBICIDE PROJECT COSTS

Project No._____ Dates (start-finish)_____
Area No. _____ Area (ha) _____
Licensee _____ Spotter A/C Type _____
Location _____ Spray A/C Type _____
Base Map _____ Spray A/C Type _____

Type of Herbicide_____ Hectares treated _____
_____ _____
_____ _____

Variable Costs	Fixed Costs
1) Spray Aircraft	1) Perm. Staff (tech.)_____
Cost/hectare_____	2) Perm. Staff (Prof.)_____
Project cost_____	3) Dept. Vehicles _____
2) Ferrying Cost _____	4) Cost Dept. Equip. _____
3) Spotter Cost _____	5) Other _____
4) Casual Employees _____	
5) Room & Board _____	COMMENTS:
6) Groceries _____	
7) Vehicles (rental) _____	
8) Equipment Cost _____	
9) Herbicide Cost _____	
10) Road Blockers _____	
11) Other _____	
TOTAL _____	TOTAL _____

TOTAL COST, VARIABLE & FIXED _____
VARIABLE COST/HECTARE _____
FIXED COST/HECTARE _____
TOTAL COST/HECTARE _____

GLOSSARY

Active ingredient - The chemical in a herbicide formulation that is primarily responsible for the phytotoxicity of that formulation and is identified as such on the product label.

Adjuvant - Any substance added to the herbicide formulation or the spray mix to improve the application or effectiveness of the formulation.

Emulsifier - A substance which reduces the surface tension of a liquid that is in contact with another such that the suspension of one liquid in another is promoted. By affinity of one end of its molecule for one liquid and the other end for the other liquid it produces the largest possible surface interface between liquid phases.

Formulation - A herbicidial preparation containing both active and inert ingredients.

Hydrolysis - A chemical decomposition involving the addition of water elements.

Surfactant - A substance added to a spray mixture that, through a decrease in surface tension, improves the emulsifying, dispersing, spreading, wetting or other surface modifying properties of liquids.

Suspension - A mixture of finely divided particles evenly dispersed in a solid, liquid or gas.

Volatilization - Rapid evaporation of a solid or liquid at normal temperature when exposed to the air.

Wettable powder - A finely divided dry pesticide formulation that is normally of low water solubility but can be readily suspended in water.

Largely taken from:

Beste, C.E., N.E. Humburg, H.M. Kempen, R.O. Radke, J.D. Riggleman, J.F. Stritzke and G.R. Miller. 1983. Herbicide handbook of the Weed Science Society of America (Fifth edition). Weed Science Society of America, Illinois. 515 pp.

Hamel, D.R. 1981. Forest management chemicals - A guide to use when considering pesticides for forest management. U.S.D.A. For. Serv., Agric. Handbook No. 585. 512 pp.

Newton, M. and F.B. Knight. 1981. Handbook of weed and insect control chemicals for forest resource managers. Timber Press, Beaverton, Oregon. 213 pp.

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PART I - HERBICIDE PLANNING (SUMMARY)

Weed species have both adverse and beneficial effects, and these must be considered for each site.

A simple, reliable competition index is difficult to formulate and apply because of the number of interacting variables involved.

Control of weed competition is difficult due to variation in the phenology, propagation methods and herbicide susceptibility of weed species.

There is a lack of long-term quantitative data on changes in wood volume of crop species after control of competing species with herbicide; thus, current decisions regarding herbicide usage must rely on conjecture and opinions of experienced personnel.

To minimize the need for herbicide treatment there should be as short a time as possible between harvest and stand establishment and the crop species should be adapted to the particular site.

Specific management goals should dictate the tolerable level of competition on any particular site. The possibility of reduced seedling survival provides greater impetus for treatment.

High quality, well drained sites that have had extensive soil disturbance should have high priority for treatment.

Raspberry is the most detrimental competitor because of the tremendous biomass and uniform coverage it can achieve. There is a substantial biomass increase around the third year of occupancy; herbicide treatment should occur prior to this increase. Treatments should not be carried out during the first year after disturbance because all buried seeds may not have germinated.

To establish consistency in the decision-making process regarding treatment, sites should be examined in late summer when competition is evident. Due to the limited time period for treatment, anticipation of potential problems is critical. Control is normally more difficult to achieve on severe problem areas.

Site preparation herbicide treatment may provide the maximum potential for uninhibited crop species growth; however, the probability of retreatment is normally higher. Such treatment is most advantageous when crop species are sensitive to herbicides (e.g. larch), competition is unacceptable prior to planting or when browsing problems are anticipated.

"Release" herbicide treatments should normally take place in the first or second growing season after stand establishment; if competition is going to be a problem it is usually evident by that stage.

Stands that have experienced several years of competition might be considered for release but the ability of the crop species to respond, the amount of survival and the potential for fill planting are important economic considerations.

Success of a herbicide treatment should be measured by the response of the crop species; complete removal of weed species is not necessary.

Strong feedback mechanisms are needed to quantify both the short-term and long-term effects of herbicide treatments.

The development of functional crop species growth models may result in improvement to the decision-making process regarding herbicide usage.

Additional research in the fields of site classification, maximum sustainable levels of competition and application technology will ultimately improve the effectiveness of herbicide programs.

AERIAL-GROUND APPLICATION (SUMMARY)

Aerial herbicide application is normally most efficient on large scale operations; small and/or irregularly shaped areas may be more effectively treated via ground application.

Application can only occur during proper weather conditions to reduce the incidence of drift and volatilization losses.

Foliage spray droplets should normally have a volume mean diameter of 500 to 800 microns; larger droplets may be used when a root uptake herbicide is applied. Mean droplet size can be altered through modifications to the delivery system and additives to the spray mixture.

The total spray volume and amount of active ingredient applied vary with the stratification of the target vegetation, type and phenology of the crop and target species, the time of year and financial constraints.

In aerial applications, both the aircraft and attached herbicide delivery system must be calibrated to ensure proper spray volume dispersal, coverage and mean droplet size.

Release height for aerial operations is normally 23 m (75 ft.) or less above ground.

Helicopters are generally more versatile and advantageous than fixed-wing aircraft. The boom and nozzle system is the most common aerial delivery system.

Uniform coverage is normally more difficult to achieve with ground application equipment; detailed calibration is not common.

Total spray volumes are higher with ground applications in order to achieve adequate coverage.

There are a variety of ground application methods and equipment. Mist blowers may provide better coverage than hydraulic sprayers; however, the latter has greater flexibility in mode of application.

HERBICIDES (SUMMARY)

Selection of a herbicide should involve consideration of its initial cost as well as its predicted effectiveness and the subsequent necessity of additional treatment.

Herbicides must be registered under the Pest Control Products Act and be approved by provincial environment and health departments before they can legally be used.

Foliar spray applications are normally restricted to late summer or fall, after the crop species have "hardened off" for the season and prior to the first killing frost.

Roundup is a foliar spray registered for both aerial and ground usage; translocation within plants is good. It is sold as a water soluble liquid and may be used for both site preparation and release work.

Applications of 4.66 to 9.32 L/ha (0.5 to 1.0 U.S. gal./ac.) of Roundup provide good control of most weed species, particularly raspberry and aspen.

Esteron and For-Ester EC are foliar sprays, containing 2,4-D, that are registered for both aerial and ground usage. They are sold as low-volatile ester emulsifiable concentrates and can be used for both site preparation and release work.

Applications of Esteron and For-Ester EC ranging from 2.2 to 3.4 kg/ha (2.0 to 3.0 lb./ac.) of active ingredient are effective against willow, alder, birch and pin cherry. However, they are ineffective in controlling raspberry, grasses, sedges, ferns, aspen and maple.

Garlon 4 is a foliar herbicide that may soon be registered for both aerial and ground usage. It is sold as an emulsifiable concentrate containing a low-volatile ester of triclopyr.

Garlon 4 application rates ranging from 2.2 to 4.5 kg/ha (2.0 to 4.0 lb./ac.) of active ingredient generally provide a broad spectrum of weed species control. Garlon 4 is not as effective on raspberry and aspen as Roundup, and is ineffective on grasses. However, it is more effective on maple.

Velpar L is a root uptake herbicide that is currently registered for ground usage in site preparation work. It is sold as a water soluble liquid; hexazinone is the active ingredient.

Velpar L application rates ranging from 2.2 to 4.5 kg/ha (2.0 to 4.0 lb./ac.) of active ingredient are common. It is effective on grasses, other herbaceous weeds, raspberry and aspen.

Velpar L applications should normally take place in the spring.

Simazine and amitrole are the active ingredients in several herbicides that are registered for ground application control of grasses and other herbs.

Asulam is the active ingredient in Asulox F, a herbicide largely used for control of bracken ferns.

APPLICATION PROCEDURE (SUMMARY)

Certification of pesticide applicators and the issuance of licenses for Pesticide Operators and Vendors are controlled under the New Brunswick Pesticides Control Act.

All pesticide applications, except for ground applications carried out by certified applicators on their own land, require a permit issued from the Department of the Environment.

The Department of the Environment can halt a spray operation at any time.

All facets of any particular operation should be included in tenders or contracts.

A uniform reporting system, including a field "check-list" and a dispersal load record, should be developed to record all pertinent information associated with a herbicide program.

Prior to commencement of operations all personnel should be familiar with the herbicides in use and be properly instructed regarding their functions and what to do in the event of an emergency. They should be properly equipped and clothed.

Appropriate emergency equipment and first aid material must be available on site.

All areas scheduled for herbicide treatment should be examined prior to operation commencement to identify any obstructions or sensitive areas and to locate airstrip or heliport sites, as well as mixing-loading sites.

Every area to be treated with herbicide should be clearly delineated and access by non-authorized personnel prevented.

Flight lines should normally be parallel and lengthwise within spray blocks, preferably perpendicular to the prevailing wind direction, and generally avoid an east-west orientation. Spray booms should be shut off in ample time prior to turning.

Procedures prior to and during the herbicide application should be carried out in an orderly and efficient manner to make the best possible use of favorable application conditions.

Operations should be constantly monitored for equipment problems and the onset of unfavorable weather conditions.

Upon completion of operations both the dispersal and mixing-loading apparatuses should be rinsed and the rinsings applied to the treatment area.

All empty containers must be rinsed three times, with the rinsings added to the spray mixture, and then properly disposed of.

All equipment involved in the operation should be cleaned and/or flushed.

Herbicide and adjuvant material must be properly stored.

In the event of a herbicide spill the appropriate authorities must be notified and emergency procedures specified by the New Brunswick Department of the Environment carried out.

Both day-to-day and longer term analyses of every herbicide operation should be carried out. The former may result in immediate improvements to some facet of the operation while the latter involves examination of species response patterns over one or more years.